SCIENTIFIC AMERICAN SUPPLEMENT No. 414

Scientific American Supplement, Vol. XVI., No. 414.
Scientific American, established 1845.

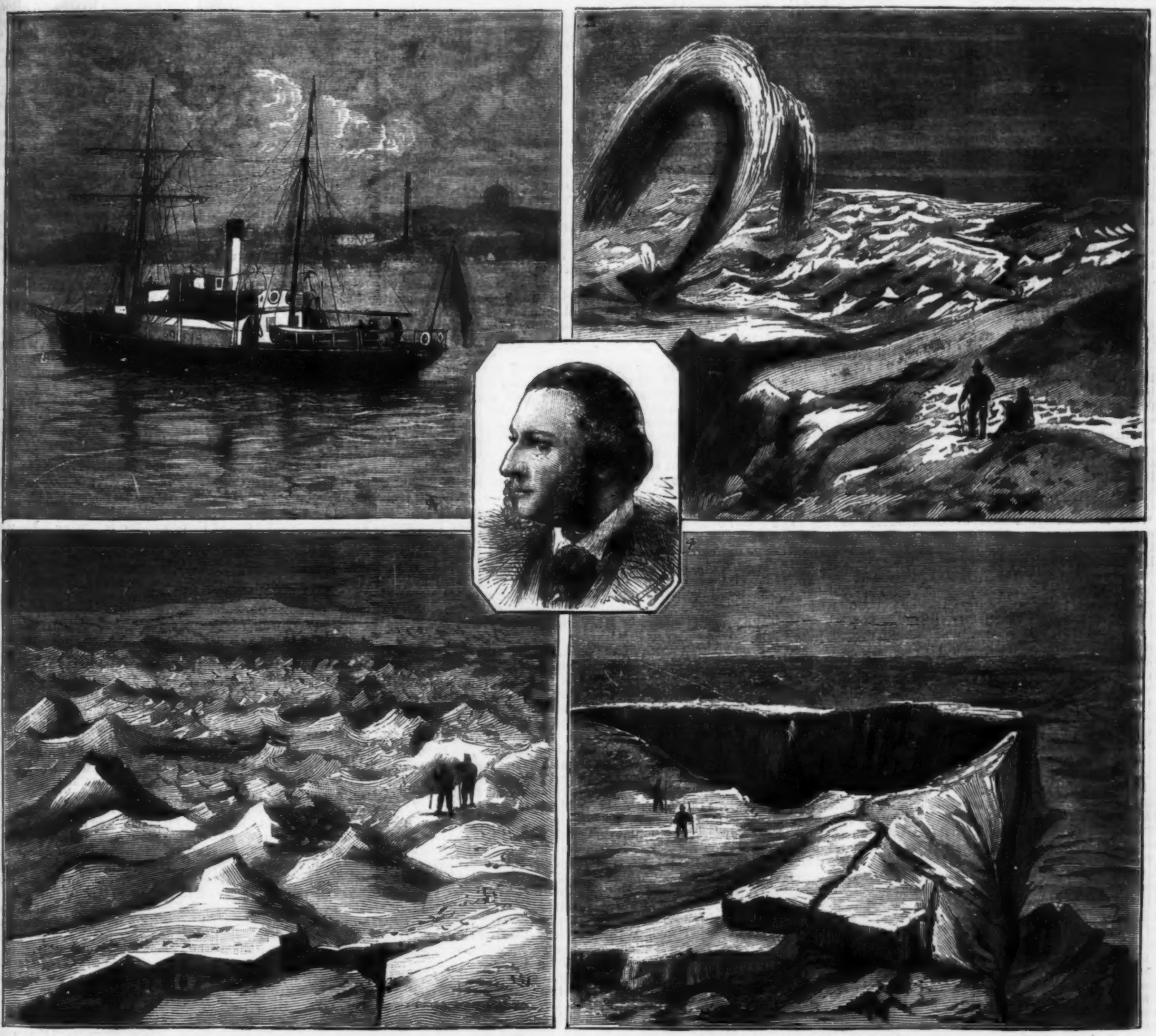
NEW YORK, DECEMBER 8, 1883.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

THE NORDENSKJOLD GREENLAND EXPEDITION.

On the night of June 10, 1883, the Sophia, the vessel in which Nordenskjold effected his expedition, steamed out of the port of Reykjavik, in Iceland; and two days after, at 7 A. M., the east coast of Greenland rose in view. At first it appeared, from the clear sea and the thousands of sea-birds wheeling in the air or swimming in the sea, as if Nordenskjold would have the good fortune to reach the east coast of Greenland, where no ship has been able to anchor for four centuries, almost at the very moment of his approach. Land was, however, found to be further off than at first believed, and, after a six hours' steaming, the man in the crow's nest reported, "Ice along the coast as far as the eye can reach." For several days the vessel steamed along the ice-barrier without discovering the smallest opening in the same. The coast was mostly hidden from view; but at times the clouds cleared away, and magnificent glimpses of Alpine scenery, lofty mountains, and shining glaciers broke into view. As there was, however, not the slightest indication of the ice disappearing, the Sophia made for Julianshaab, on the west coast, and thence northward along the shore to the Auleitsivik Fjord, from the bottom of which the famous Swedish explorer would start on his exploration of the interior of Greenland. On July 4 all was ready, and Nordenskjold and his party departed on their expedition. For about a fortnight the journey was continued across a *flora-* and *fauna*-less icy desert, when a heavy snow arrested further progress on sledges. Now the two Lapps in Nordenskjold's train were sent forward in "skidor," viz., Lapp snow-shoes. They traversed some one hundred and thirty miles and found no change in the character of the land. The ice had every appearance of having lain here since the Glacial period. Still, the fact that hot springs are now and then encountered in the interior seems to bespeak a subterranean heat similar to that producing the "geysers" of Iceland. The excursion into the interior occupied a month, when the party returned to the point of starting.

The Sophia had, in the mean while, in charge of the well known Swedish geologist, Dr. A. G. Nathorst, proceeded on a scientific voyage up Smith's Sound. The main object of this expedition was to land at Cape York, and examine some large blocks of ironstone which Nordenskjold discovered here in 1870, and which he believes are of meteoric origin. Heavy pack-ice, however, blocked every approach to Cape York, and the Sophia had to return to Upernivik, and then to take the inland expedition on board. When this was successfully effected, the course was again shaped for the east coast, in order to attempt to make a landing there. But even now a thick belt of drift-ice barred every approach, and it was first on September 4 that Nordenskjold succeeded in forcing the same, and anchoring in a fjord south of Cape Dan. The Sophia is thus the first steamer which has reached the east coast of Greenland, south of the Polar Circle, while Nordenskjold and his followers are the first Europeans who have succeeded in landing in this latitude since the fifteenth century. In this fjord some remains were found, which the Swedish explorer attributes to the Norse colonists of Greenland eight centuries ago. On September 28 the Sophia arrived at Gothenburg. The munificent equipper of this expedition is the well known Mæcenas, Dr. Oscar Dickson, of Gothenburg, whose portrait we give, together with an illustration of the Sophia and some views of the icy interior of Greenland. The foregoing details, and the sketches, are supplied to us by Mr. Carl Siewers.—*London Graphic.*



1. The Sophia, Nordenskjold's Exploring Vessel. 2. View of the Inland Ice in Greenland with Intermittent Hot Spring, Thirty Miles from the Coast. 3. The Inland Ice at the Furthest Point Reached by Human Beings. 4. View in the Interior, with Enormous Crevasse in the Ice. 5. Dr. Oscar Dickson, at whose Expense the Nordenskjold Expedition was Equipped.

THE NORDENSKJOLD GREENLAND EXPEDITION.

[For a more extended account of the Greenland expedition, also portrait and biographical sketch of Prof. Nordenskjold, see SCIENTIFIC AMERICAN SUPPLEMENT, No. 409.]

HOLLAND, in the last three centuries, has recovered from the sea at least 90,000 acres. The lake of Haarlem became terra firma between 1840 and 1852, and the Zuyder Zee is in process of transformation into 500,000 valuable acres. Holland has now 1,479,000 oxen and cows, and her present output of cheese is estimated as worth $3,000,000.

EARTHQUAKE WAVES.

ALTHOUGH a number of earthquakes have occurred in California since it has been settled by Americans, none of them have been of such a character as to cause serious loss of life; and with none of them have we ever had a tidal wave. Where great earthquakes occur at or near a coast line, there is generally a resultant tidal wave of greater or less height. These waves do not necessarily occur at the moment of the shock, but may appear an hour or more afterward. We have in this harbor an instrument for recording the height of waves, and its arrangement is such that it records earthquake waves also, and in such a manner that their presence is always detected, even when the earthquake occurs in South America, Japan, Java, or other places a great distance away. This self-recording gauge is maintained by the U. S. Coast and Geodetic Survey, and at the last meeting of the California Academy of Sciences, Prof. George Davidson described its construction and operation and exhibited diagrams of the markings.

The subject is one of considerable interest, and is one little understood by the general public. The gauge not only records the rise and fall of the tides, but the presence of unusual waves on the bar at the Golden Gate, as well as earthquake waves. A properly ruled sheet of paper is moved along by well regulated clock work, so that about an inch of paper passes a given point in an hour. During this time a lead-pencil point impinges on the paper. This pencil is actuated by wheels connected with a peculiar float on the surface of the water. The pencil moves across the paper one inch to a rise of one foot of the sea. The box containing the float is so arranged that ordinary small waves do not affect the record of the pencil. At a point below the lowest level of the float there are holes in the box, to admit free movement of the water and give the level of the sea, regardless of small waves in the harbor or in the offing. When there is heavy sea, part of the holes are closed.

There are some curious phenomena exhibited by this gauge, or rather brought to light by it, at the "slack" of each high and low water, depending on the characteristic of the entrance of a harbor. If an entrance is "throttled" or narrowed as it is in San Francisco, the incoming flood-tide will have to force its way against an ebb running six knots an hour. To do this the young flood must come in along the bottom like a wedge and widen out. It must lift the whole outward moving mass over it. The recording pencil of the gauge shows the rise at the slack water. But this water wedge is soon overcome by the outgoing volume, and spreads out, so a slight fall then takes place. The pencil records this too. These changes occur at each high and low water.

There are tides which occur in this harbor where the fall from the "small high" to the "small low" is only about a foot, and sometimes even less; but a neap tide will run down to six or seven inches only.

Ordinary waves are not registered by the apparatus inscribed. With a breaking bar, however, the gauge takes up the register, and in addition to the usual tide curve inscribed by the pencil, a serrated or "jigged" line is made, indicating this wave action. On the register this is very plainly marked. It will record the impulses of great breakers on the bar of San Francisco, and will also record impulses which have either a longer line of movement where the level is sustained for more than three minutes, so the float will be lifted.

As early as December 25, 1854, earthquake phenomena were recorded here, and waves were recorded constantly to the 1st of January following. There were no telegraphic or quick means of communication with the East or with the South America or Japan in those days. The Coast Survey sent word to Washington about the disturbances, saying an earthquake must have occurred at some distance from here. It was not until the following June that this was corroborated. The waves rose 0·65 of a foot at San Francisco, and they were recorded also at San Diego and Astoria.

In 1868 the Arica (Peru) earthquake occurred, on which occasion the United States steamer *Wateree* was lifted by a wave forty feet high and carried far inland. These waves were propelled to these shores, and were recorded here. One was two and one-half feet high, but they averaged eighteen inches. They had to travel 4,500 nautical miles to reach San Francisco. The wave motion continued for six or seven days, though at Arica the tidal wave continued but seven hours. The only explanation of this is, that the waves carried across the Pacific were reverberated, and returned again, several times before subsiding. The same wave would travel over to the Australian or Japanese coast, and come here from there again, crossing the ocean several times.

At the time of the earthquake at Arica there was no change in the surface of the water for 30 or 40 minutes, and then the great waves began to come and go. There were five great waves in the Simoda (Japan) earthquake of 1854, but seven or eight came to us here; so there must have been two reflex waves. So in Arica in 1868, the waves came here, one two feet high, and averaging one foot. They came at intervals of 35 minutes; and in addition to the main waves inferior ones were recorded.

In 1877, while the gauge was smoothly recording the low water of May 10th, it began also to record earthquake waves from an earthquake at Iquique in South America. At the time of this great earthquake, at the Chincha Islands there was no motion of the water for some time; but late in the evening the water began to recede, and the people saw bottom where a short time before there were 100 feet of water. The wave on the main shore was 65 feet, so the center of the turbulence was off at sea somewhere. Our gauge here showed a rise of one foot. For several days there were waves, some as high as 17 inches, and some very well marked high crests. The interval between the crests of the waves was 45 to 50 minutes.

On the 27th of last August, at 2 A. M., the local gauge began to record earthquake waves. At noon the average height of the coming waves was about one foot. This motion continued for three days. The markings were, however, less characteristic than those of 1868 or 1877. The reason of this was, in a great measure, that so many obstacles intervened between this port and Java, where the earthquake occurred, the waves passing through narrow straits to get to the ocean. The distance from San Francisco, on great circle, to the northwest part of Java, where the center of the shock occurred, in 8,960 miles.

When the time of the original appearance of the wave at the central point is known, the average depth of the ocean between this point and that can be told. The rate of progress bears a certain relation to the depth of water. The Simoda earthquake waves had to travel 4,500 nautical miles, and they came in twelve hours and thirty-eight minutes. The velocity was 358 miles per hour, or 6 miles a minute.

Airy has shown that in what is called the free ocean, where the water is 2,230 fathoms or more, a wave traveling that distance should reach this shore in the above time.

This agrees with the soundings made by Commander Belknap on the Tuscarora in 1873. There is a plateau of 2,200 fathoms deep running from this shore nearly to Japan, deepening somewhat as it nears that coast.

In the Arica earthquake of 1868 the wave ran 4,480 miles. It was attempted to deduce from its speed the depth of ocean, but several features presented themselves which prevented fair deductions. Thus the deduced depth to San Francisco was 1,800 fathoms, but it is known that the plateau is 2,200 fathoms

From Arica to San Diego the depth on the average is 2,718 fathoms. Coming north of San Diego the change in the trend of the coast line and the interference of the Santa Barbara Islands acted as obstruction to free movement of the great wave, and thus retarded it.—*Mining and Scientific Press.*

WHERE DID THE CYCLONE FIND ITS WATER?

THROUGHOUT all the wide desert region east of the Sierra Nevada, for hundreds of miles, the violent meteoric phenomena which within these last few years have become so commonly known as "cyclones" are by no means uncommon, though they are called by a different name. In Nevada, Utah, etc., they are universally designated water spouts, and when a "spout *bursts*" within the range of a settlement, the devastation is often frightful, and where the occurrence is in a wild region its track is marked for years and ages to come. But the indications are somewhat different from those which we observe as left by the passage of a cyclone in the Mississippi Valley, and eastward. Here a very large part of the destruction is accomplished through the irresistible fury of the whirling and advancing wind. There, though the wind is always violent, it is seldom sufficiently so to do much injury. The fearful manifestations consist in the down-pouring of perfectly incredible quantities of water; quantities which would be utterly beyond belief were not the evidence left for all to read, in all time to come.

The name "water spout" is a very natural one, and will doubtless long be retained; and inasmuch as the same feature manifests itself, to a certain extent, in some if not all of the eastern "cyclones," a brief sketch of what one western "water spout" did in the brief rage of its fury is well worth our study. We shall find that we are asking questions that we cannot answer, that the subject brings much mystery with it, but that gives only additional reason why we should ask the questions, hoping for an answer by and by.

I shall describe what I saw, five years after the outburst took place, adding to this a few statements from trustworthy men who were eye witnesses. And it may be remarked that I do not select this special water spout because it is in any degree more wonderful than others. It is only because I can give my personal testimony to the fearful sweep of the water, as shown by its foot-prints and its handiwork.

East of that mighty mountain mass of the Sierra Nevada which southerly from the Yosemite Valley culminates in the peaks of Mount Whitney, Mount Tyndall, etc., and separated from it by the broad, deep furrow known as Owen's Valley, runs a magnificent chain which has never received any other title than the indefinite one of White Mountains. It is characterized by a sharpness and angularity quite in contrast with the rounded ridges of the Sierra Nevada; and while the general elevation of the range, rising almost as abruptly as a wall from Owen's Valley, is from nine to ten thousand feet, it culminates suddenly and abruptly at its northern limit in a grand cone, at least 13,000 feet in height (never measured accurately, so far as I am aware), which is surely worthy of some more distinctive appellation than that which it bears, White Mountain Peak. However, perhaps we ought to be thankful even for this; according to the common rule of personalities, there is more than an even chance that, should it receive a new christening, the peak would go down to history as Mt. Smith, or Mt. Jones. *Oh! procul abeste profani.* It is better as it is.

Immediately north of the peak, the elevation drops at once to say 7,000 feet, and then melts away into low hills. Across the ridge, at the height last mentioned, the road from the valley on the west goes over into the Columbus Desert on the east, and so on to Silver Peak, etc. As we wound our way along up the mountain side, and over the summit, the stage driver was very affable, and I found him a man of no small amount of intelligence, as is so constantly the case with the drivers on the roads through all that strange land of mountain and desert.

Now do not fancy me perched up on the "outside seat" of a Concord coach, with six noble horses spanking off, up grade and down grade, as if the coach and its load of passengers were but a plaything behind them. That is stage coaching in the Sierra Nevada, and it is almost worth crossing the continent to see it and to feel it. I have never found its like in any other part of the world for horses, for drivers, or for roads. But this Columbus route is an outside affair. Our "stage" was a dilapidated, open, two horse wagon, with two hard seats across, on which the passengers were expected to hold themselves as best they might. The front was broken out entirely, and on the floor, with his feet resting on the whiffletree, sat John Carbeau, to drive and to talk. John had the advantage, however, of us who were passengers, for he had a bag of straw as a cushion, and that is more than we had. Our two horses, ragged looking but tough as wire, were to make the distance to Columbus, forty miles, without relief, and capitally they did it, too; but the hardest part for them was, that the last twenty-four miles were to be made without water, for that is a "dry and thirsty land where no water is." All that eastern side is like the Sahara. Across the summit breadth, and for a few hundred feet down, snow and rain maintain a moderate amount of vegetation, including a scattering growth of trees. But as you go on down, the trees fail, and in less than half a mile the desert's barrenness is all about you, the sand and rocky earth look as though they had not received even a sprinkling for untold ages past, and you see at a glance that pouring water on the surface there would be like pouring it into a sieve, and you are ready to aver that a strong and fierce mill stream might flow there for a month and not make progress of five miles down the mountain side within that time; that all would be absorbed as fast as it came.

It is right on the upper border of this desert land that our tale commences. As we were drawing near to the border of the tree growth, John interrupted himself in the midst of an account of the peculiarities of Columbus and its inhabitants. "Now, Doctor, I reckon I can show you something you never see afore. Alongside of that black rock, where we pitch into the cañon, is the place where that spout burst, five years ago this summer. We shall follow it fifteen miles down, clean out into the desert, and if you will say you ever see water cut up such capers afore you'll beat me, that is all I can say."

And sure enough, before we had gone a single mile or even a quarter, I was ready to assent to all of John's claims, and the debouchure at the end of the fifteen miles was only a fitting finish. The "capers" were indeed most astonishing, and the more they were studied the more wonderful they grew.

There was no mistaking the point at which the rush of the torrent began. We had passed from the level land of the summit plain and commenced the descent of a narrow cañon, such a one as furrows the slopes of all those barren mountain sides. For about a hundred yards all was untouched. The cañon-grooving was perhaps made originally by water, but if so it was very *old* water. The work was done ages, almost untold ages, ago. It all looked as though water had never come near it. But all at once the dash of water became manifest, and though the dash had been made five years before, its marks were as plain as though the outburst had been but a day old. It evidently struck with a fierce and a very much circumscribed force. Its breadth *certainly* did not exceed a hundred yards, and I think that fifty yards would have covered it. Within fifty yards of the upper border of the washing, the hard baked earth was torn up and tossed away, heavy stones were thrown here and there, rocks laid bare, and then the rush of the torrent down the ravine began. The bed there for a little distance was rocky and gave opportunity for a concentration of violence, and within less than a quarter of a mile it was plain to see that a mass of water at least ten feet deep had swept down the cañon with a fury that was well nigh irresistible. Rocks that weighed from one to two tons had been tossed about like feathers, and where solid rock walls cramped it at the sides, a furrow ten to fifteen feet deep had been scooped out from the solid bottom of the ravine, and carried onward to swell the mass of debris below.

Just beyond this the narrow, groove-like form of the cañon ceased for a certain distance. It became a broader, shallow valley. Here of course the torrent spread itself out, and as the whole surface was coarse sand and gravel, the water must have disappeared through it in quantities utterly beyond computation. It is very difficult for any one who has not had experience of the hot and parched desert sands to realize the fiery avidity with which they drink in water. To one with such experience the wonder would be great to imagine how water could have been forced upon it from the upper side in sufficient quantity to flow off the lower edge, except after a very long outpouring, for this broad plain stretches on nearly two miles. But cross it did in this case, and cross it furiously.

On the broad surface there was of course no great display of violence, though even here the washing was more than winter storms make commonly in our eastern regions. But where the cañon narrowed again, and the stream had been once more restricted laterally, the terrible violence was once more conspicuous in its ravages, only that the displays on the slope far above seemed like childplay compared with the fury here. I saw excavations in which easily a house, two stories in height, might have been placed. I saw huge volcanic rocks weighing many tons that had been thrown up as though they counted not that many ounces, and all along the indications of the same terrible violence were stamped and furrowed everywhere.

And on this lower range, a few miles before reaching the level plain of the Columbus Desert, were laboring ahead at the moment of the outburst the teamsters who were, so far as I know, the only human witnesses of the fearful scene. The story told by one of them was the following. He was a rough man certainly, but had every appearance of being a truthful one, and inasmuch as his report confirms so fully the inferences which I was compelled to form from my own observations, I have no doubt that he really saw what he describes. Of the losses of machinery which he narrates I had had knowledge some years before.

"You see, we was coming across the mountain, two fourteen mule teams, loaded up for that quartz-mill they was building then down to Columbus, and we had got down to about four miles from the mouth of the cañon. There had been a terrible racket up there on the summit for three or four hours, and the clouds was mighty black, and just a bilin' all the time; first one way and then the other. I had crossed there once afore, and had a big thunder shower then while we was right up in the middle of it. So I thought little about it, though it was the ugliest looking mess up above there I ever set my eyes on. The first idea I had of any trouble was hearing a roar that sounded like water coming after us, and it fairly frightened me. We had not had no drop of rain where we was, but I knowed in a minute that a water spout had burst up above, and there was danger a-comin'. There was no help for me, for right where I was the cañon was narrow and the sides steep, but just below, where Jim Carver was, with the head team, it kind o' flattened out, and I yelled to Jim to pull out to the side, and the same minute I jumped for my own mules, but before I could get more than the third pair off I see the water break around a bend perhaps a quarter of a mile above me. It was tearing along solid, sometimes two foot high, and then again it would bank up five foot and more, and it looked to me there was about as much stones as water. You bet your life, I never took my eyes off of it, till it struck me, but I was unhooking mules all the same. The last team but one was knee deep as they put for the bank, and when I cleared the pole team, mules and I had to swim for it. And I was not more than fairly up and out before away went that wagon like a chip. One of the things in my load was a thirty horse boiler, and I see it break loose and go a-whirling away just as though it was bound to get to Columbus, all on its own hook. When the fun was over we found it nigh upon two mile down the cañon, mostly buried up, just one end sticking out of the sand and stones. I had on the fly wheel, too, for that same engine, and that is somewhere up the cañon now I reckon; leastways nobody haint never seen hide nor hair of it since. And that was the way with a big part of my load. Jim come off better, for the water where he was did not float his wagon, and it stood it all safe. But there he was, one side of the water and I the other, and it was night before we got together."

Omitting the ordinary expletive, which I have not deemed it necessary to record, this is Dave's story. I believed then that he told the truth, and I think so now, for at all events it is precisely what my own eyesight assured me must have happened to any team and wagon caught at the place which John Carbeau showed me as the scene of their disaster; the loss I know occurred.

The rush of the water continued with such fury, till it spent its rage on the open plain of the desert, that acre

upon acre was piled thick with the debris swept out from the rock mouth of the cañon, which opens as abruptly as if it were the arched door of a castle wall. The thickness of this deposit, four feet more or less at its commencement, thinned away and feathered out toward the outer edge till it became nothing. It was but the token of the expiring struggle, and yet there lay many thousands of tons, from large rocks on to the finest of sand, and there they will lie for many, many years to come, just as I saw them, for they have perhaps been scarcely dampened since their first being thrown out, so fearfully dry is that desert region.

Now we are prepared to return to the question with which we started—Where did the cylone find its water? That all the volume of torrent which tore down that cañon and debouched from its outlet, fell upon the cañon entirely within the limits of its breadth is certain; that I can testify from my own knowledge and observation. Our road followed the cañon-bed where that was practicable, or along its border, or struck across a bend here and there returning to it within a short distance, so that I made personal inspection of the cañon throughout its entire length. I studied the marks of washing most minutely, and made my notes of record as speedily afterward as possible. There was no difficulty in distinguishing the border-limits of the waterfall, nor was there in determining where the lower limit was reached. Many side cañons came into the main one as we descended, and each one of them I scrutinized with much care; and I wish to make my personal guarantee for the accuracy of the statement that all that mass of water came in a down-pour from the cloud within a space which did not exceed a mile and a half in length by a quarter of a mile in width.

Dave Alden said indeed that the cloud did not hang any lower down from the summit than a mile, and it is my own decided impression that that distance covers the space to which my observations restricted the fall, but I have allowed a greater extent, so as to give the utmost reach possible. Not one of the side-cañons showed any marks of having received or discharged water; and where the main cañon was wide enough to show the full breadth of the fall, a quarter of a mile went to its outer borders and beyond them.

This exceedingly restricted space therefore was the theater of action, and yet it is as great in extent as that devastated by many a cyclone where it strikes the earth. Their blow is commonly narrow and short, unless in fact they rebound, descend, and strike again. One remarkable fact here seems to have been that it was not an advancing whirlwind come and gone with a destroying rush, but that it remained in one place hour after hour. Dave's testimony on this point was positive. When questioned closely he constantly averred that there was no sign of a driving wind up on the summit, only that "the clouds was just a-bilin' all around the head of the cañon."

What now must have been the mass of the water whose work we have been discussing? Consider the fury displayed in its downward rush; consider the indescribable avidity of the desert sand for its absorption; and consider the distance to which its current reached while flowing over such an elongated sieve-bottom. I can scarcely believe that, could the Croton Aqueduct be discharged in full stream into the head of that cañon for the space of two hours, there would be any outpour whatever into the Columbus Desert; I think it would all be absorbed. But the torrent from the clouds swept outward as fiercely as I have stated.

All the moisture which even a saturated atmosphere could contain in a column of the size stated, extending upward from the earth to the atmospheric limit, if it could in some manner, no matter what, be so condensed as to fall to the ground within the time mentioned, would be absolutely nothing to that with which we have to deal. But we know that in a whirlwind, which we may consider a probable factor here, we have a powerful in-draught from every side, whose influence we are to admit. Allowing that in-draught to extend for miles, and to sweep in all the moisture therein represented, which is a thing perhaps not within the range of possibility (and there is certainly no evidence of any such extended action), even then we do not approach a solution. It must be remembered that all of that atmosphere would be not saturated, as we hypothetically took it a moment ago, but already dried to a desert parching, and miles upon miles of it would not give us enough to saturate the sand, and flow onward five miles even gently, much less that fiery torrent of fifteen. And we must end as we began—Where did the cyclone find its water?

THE PHYSIOLOGICAL STATION AT PARIS.*

THE black screen in Fig. 1 consists of a sort of shed 3 meters in depth, 15 in length, and 4 in height. Such a height is necessary when the flight of birds is being photographed, since these, in rising, soon get out of the dark field. When the walk of men or animals is under study, the screen's opening is diminished in size by suspending from its upper part frames covered with black cloth, so as to lessen the amount of light entering the shed, and to render its cavity darker. Moreover, a long piece of velvet, 2·5 meters in height, occupies the entire back part of the shed. In this way, the light emitted by the back of the screen is almost entirely suppressed.

FIG. 1.—ARRANGEMENT OF THE SCREEN AND CHRONOGRAPH.

In Fig. 1 a man wholly clad in white is seen walking in front of the black screen. The track upon which he is walking is slightly inclined, so that a visual ray, emanating from the objective, just grazes the surface of the ground, so to speak, without coming into contact with it at any point. This is a necessary condition in order that, in the images, the fact of those who are walking shall be visible while the ground is not. Without such an arrangement the light reflected by the earth would act upon the sensitized plate at the very points where the image of the feet should be taken, and render the latter confused. This track is elevated about 20 centimeters above the surrounding earth, and, all along this prominence, there runs a board upon which are painted divisions that are alternately white and black, and that are each 1·5 meters in length. This divided rule is depicted in the photographs, and serves to measure the lengths traversed between two successive images, to show the stature of the subject, the amplitude of his reactions, and the extent of the movements of every part of his body.

In order to know the velocity of the motions, it is necessary to measure the time that it takes to traverse the different routes. Now if the wheelwork that actuates the disk had always the same velocity, and if the number of apertures was the same for all the experiments, we should only have to determine, once for all, the interval of time that elapses between two images, and we should then have at the first glance an expression of the velocity. In fact, if the successive exposures are separated by $\frac{1}{10}$ of a second, and if the interval between the images (measured from the scale of lengths) is 0·5 meter, it is clear that 5 meters have been traversed in one second. But the speed of the disk varies according to the nature of the experiments, and it, therefore, becomes necessary to control it. Such a control might be obtained by means of an inscribing chronograph that indicated the interval of time that elapsed between the different revolutions of the disk while the experiment lasted. But this method would give two sorts of independent indications—that of spaces upon the photographic plate, and that of time upon a revolving cylinder. It has seemed to us preferable to obtain upon the plate itself an indication of the time that elapses between the successive images. Such a result has been reached in the following manner:

In order to ascertain the frequency with which the disk revolves, it suffices to successively photograph the position of a body moving at a uniform and known speed. Fig. 1 shows, above the head of the walker, the apparatus that serves for this purpose, and that we shall call a "photographic chronograph." It is a velvet dial whose circumference is divided into a certain number of equal parts by brilliant nails arranged in a circle. A bright hand revolves continuously over the surface of this dial with a speed of one revolution per second. It is clear that if the disk of the photographic apparatus made only one revolution per second, we should have but one image of the hand upon the dial. If the disk made 6 revolutions per second, we should have 6 images, etc. When the speed of the disk is uniform, the images are equally spaced upon the dial. The divisions of the latter permit the fraction of a second corresponding to the interval between the images to be easily estimated. The use of this method will be better understood if we consider one of the applications of it. Fig. 2 represents a leaper bounding over an obstacle. The series of photographs begins at the moment that he is taking a preliminary run to make his jump, and finishes when the latter has been effected and the striking of the ground has partially slackened the velocity of the fall.

Let us analyze this figure. We see that the leaper is represented 9 times, that is to say, 9 rotations of the disk have occurred during the course of the experiment; and, each rotation bringing the aperture in the disk opposite the objective, has allowed the light to pass for an instant, but sufficiently long to give an image each time. These successive images have been produced at differents part of the plate because the leaper was himself occupying different positions in front of the screen when each of the exposures was made. The space passed over, either on the earth or in the air, during the interval between two images is easily measured by means of the divisions of the rule placed below the figure. It will be seen that such interval is not always the same, and that if we suppose that equal intervals of time have separated the successive images, the greatest speed occurred in the run that receded the leap, that a check in the speed occurred while the leaper was in the air, and that, finally, there was a further check after the fall, the speed being partially lost at the moment his body struck the earth.

In order to ascertain whether the images have been formed in equal intervals of time, and what the duration of such intervals has been, the dial of the chronograph must be consulted. By this it will be seen that the luminous hand has been represented as many times as there have been exposures, that is to say, 9 times, and that the intervals between the exposures have been constant, since the images of the hand, whose rotation was uniform, make equal angles with each other. Finally, the absolute value of the intervals of time that separate the exposures is expressed by the angle that the images of the needle on the dial form with each

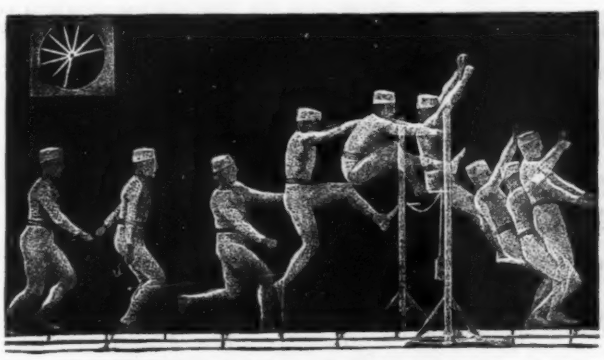


FIG. 2.—INSTANTANEOUS PHOTOGRAPH OF A MAN JUMPING OVER AN OBSTACLE.

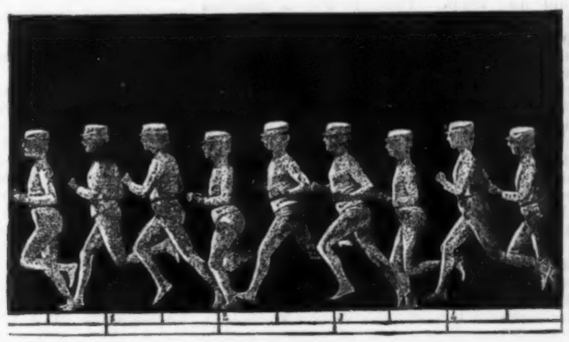


FIG. 3.—INSTANTANEOUS PHOTOGRAPH OF A MAN RUNNING.

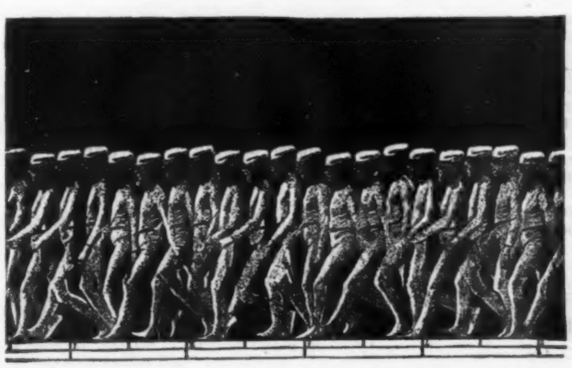


FIG. 4.—INSTANTANEOUS PHOTOGRAPH OF A MAN WALKING.

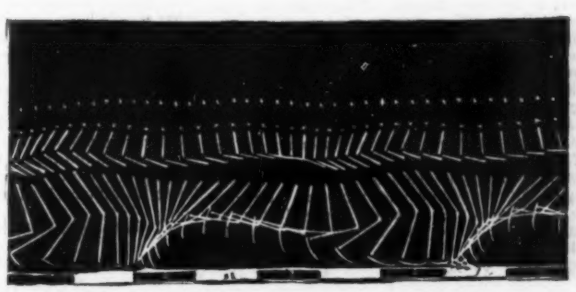


FIG. 5.—INSTANTANEOUS PHOTOGRAPH OF BRILLIANT STRIPS OF METAL AFFIXED TO THE LEGS AND ARMS OF A PERSON RUNNING.

* Continued from page 6514.

other. Such angle is about 36°, thus showing that the interval of time between the successive exposures is $\frac{1}{10}$ of a second.

From these measurements of time and space, we easily deduce the speed of the leaper at the different phases of the experiment. Such speed was 7 meters per second during the preliminary run, 5 during the leap, and 3·5 after the fall.

Partial Photographs.—When a series of photographs representing the successive attitudes of an animal is taken upon the same plate, we naturally try to multiply the images in order to ascertain the greatest number of phases possible that the motion has assumed. But, when the motion of the animal is not rapid, the frequency of the images is soon limited by their superposition and by the confusion that results therefrom. Thus, a man who is running, even with moderate speed, can be photographed from nine to ten times per second (Fig. 3) without the images being confounded with one another. If, at times, a leg comes to be depicted at a place where another one has already left its imprint, such a superposition does not spoil the images, for the whites only become the more intense at the spots where the plate has been twice acted upon, so that the contours of the two limbs may still be easily distinguished. But when the man is walking slowly, as in Fig. 4, the images exhibit superpositions so numerous that great confusion results therefrom.

Such an inconvenience is remedied by *partial photography*, that is to say, by suppressing certain parts of the image in order that the rest may be more easily understood.

As, in our method, white and brightly lighted objects act alone upon the sensitized plate, it suffices to clothe in black such parts of the body as we wish to eliminate from the image. If a man clad in a costume half white and half black walks upon the track with the white side of his clothing turned toward the photographic apparatus, he will appear in the images as if he had but a single side.

These images permit of following in their different phases, on the one hand, the pivoting of the lower limb around the foot during the time it is planted, and, on the other, during the time it is being lifted, and the oscillation of this same limb around its articulation with the thigh at the very time that the articulation is continually moving forward.

Partial photographs are likewise useful in the analysis of rapid motions, because they permit of greatly multiplying the number of attitudes represented. However, as the image of a limb presents considerable width, we cannot greatly multiply these partial photographs under the penalty of confusing them through superpositions. It becomes necessary, then, to further diminish the breadth of the images, in order to repeat them at extremely short intervals. The way this is done is to clothe the walker in a costume which is entirely black and which is provided with narrow strips of brilliant metal along the leg, thigh, and arm, that show pretty exactly the direction of the bony radii of these limbs (Fig. 5).

This arrangement permits of easily increasing the number of images tenfold that are taken within a given time upon the same plate. So, instead of ten photographs per second, we can take a hundred. To do this we do not change the speed of the disk's rotation, but, instead of giving it a single aperture, we give it ten, which we distribute equally over the entire circumference. It is necessary to make the diameter of one of these apertures double that of the others, in order to obtain greater width in one of the images, so as to facilitate the estimation of the time and get datum points for comparing the motions of the lower limbs with those of the upper. The images obtained under such circumstances are so close together that we get all the successive movements of the limbs and trunk. Thus, in Fig. 5, between two successive points of the right foot, there are twenty-one different positions of the lower limb. At the moment the foot meets the ground the knee perceptibly bends, and then stretches out at the instant at which the foot, in resting upon the point, is preparing to leave the ground. After the foot is lifted the knee bends again, and the leg forms perceptibly a right angle with the thigh, and then it gradually straightens; and the sole of the foot, which was at first in a vertical plane, becomes sensibly parallel again with the earth that it was grazing long before planting itself anew. The scale placed at the bottom of the figure shows that the total length of step was 2·6 meters. The chronograph was not used in this experiment, but we can estimate that the number of images was about 60 per second. The motions of flexion and extension of the fore-arm upon the arm are read in the same manner as those of the leg. The oscillations of the head are expressed by the undulatory motions of a shining point placed on a level with the air. In order to determine the corresponding attitudes of the arm and leg at a given distant, we take as a datum point those larger images that are reproduced one time out of fire. These images were formed at the moment that one of the wider apertures in the disk was passing, and they correspond, therefore, to the same instant. This is not the place to analyze in detail the different types of locomotion, but the few examples that have just been given will suffice to explain the method employed, and to show the accuracy of which it is susceptible. For a complete study of human locomotion it is necessary to collect photographs taken under most varied conditions, and the subject should be photographed not only from the side, but also from front and rear, so as to render visible the lateral oscillations of the different parts of the body.

Finally, after analyzing the mechanism of the different acts of walking or running, these acts must be studied in their final result, which is the more or less rapid forward movement of man, either while walking freely or dragging or carrying a load.

Such researches have a practical interest that is analogous in all respects to those whose object is to determine the duty of an engine, and the conditions most favorable to it.

Experiments with regard to these matters are now in course of execution, and it is for this purpose that the circular track has been established, along with telegraphic signals designed for inscribing the phases of walking or running. In a subsequent article we shall make known the results obtained in these experiments.—*E. J. Marey in La Nature.*

COLOR OF WATER.

By W. SPRING.

PURE water has in itself a blue color if observed in a stratum of sufficient thickness. In natural waters which appear blue calcium and magnesium carbonate, silica, and alumina exist in solution. In green waters the same salts exist, from deficiency in carbonic acid, in imperfect solution or in partial suspension.

LARGE SHARK, COLOMBO MUSEUM.—LARGEST TREE IN THE WORLD.

To the Editor of the Scientific American:

I observe that Mr. Theo. Gill, of the Smithsonian Institution, was good enough to notice critically in your issue of 28th July, page 53, my little contribution appearing in a previous number, anent the large shark in the Colombo Museum: I therefore inclose herewith a newspaper cutting reproducing a technical description of the animal, by Mr. A. Haly, director of the Museum, published in the *Annals and Magazine of Natural History*, for July, 1883, and in further connection with the subject have to say that, although Mr. Gill declares that the creature, meaning I suppose the *genus*, has lots of teeth, and Mr. Haly reports this one in particular as having them in plenty, I submit that those authorities are only technically correct, as the minute filaments slightly roughening the cartilages about the mouth are teeth only in the jargon of natural history, and from a professional point of view; whereas, I was not writing professionally; and, commonly speaking, or in comparison with other members of the shark family, the animal in question is as I described it, viz., toothless, and the insertion of the word filamented, between strong and cartilaginous in the original letter, will render the description perfect. To my mind those little fibers are not near so large even as Mr. Haly's measurements indicate; and they are shark's teeth only metaphorically, just as in nautical phraseology, the "teeth of the wind" is the direction from which it blows; and that is mostly the idea of all who have seen the specimen, some people going so far even on this account as to declare it to be not a shark at all, but a young whale!

I am no naturalist, nor much of a scholar; and when I penned that cursory letter about the shark I merely described what I had seen, without any idea, motive, or, I believe, appearance of poaching upon scientific preserves. I did not even concern myself about the apparent anomaly of calling a fish without teeth a shark, though I had heard or read that the creature reputably got its name from a Greek phrase signifying sharp teeth, and in furnishing the list of some of the sharks inhabiting Ceylon waters, I merely quoted from respectable authorities, and if my statement was incorrect (as Mr. Gill puts it) it was hardly sufficient for that gentleman to merely contradict me, but he should have pointed out what type of the species I had wrongly named.

I admit that *Rhyncobates Ancytortimus* is strictly speaking a skate, as would have been mentioned at the foot of my letter had not my memory served me a trick, but in other respects the enumeration so far as it goes is, in my opinión, correct.

It behooves non-professional people, apparently, in these enlightened days, to be careful about even seeming to approach the field of scientific research, lest some grave authority should hurl the contents of a ponderous tome at the head of the intruder, and make him out a fool directly. Such, your readers will probably recollect, was the case with Mr. H. M. Stanley, who, after finding Dr. Livingstone in Africa, was, to his great chagrin, told by certain members of the Geographical Society in London, who perhaps had not themselves ever been out of Europe, at most, that he could not possibly have met the Doctor; and to their own satisfaction, at least, they proved to his face that he never was near the place where he found that celebrated traveler! It certainly was rather rough on those sapient *savants*, that subsequent developments upset their geographical conclusions, and vindicated Stanley; and the moral of it all probably is, unprofessional people, approaching the realms of science, in writing of what they view, should bear in mind that they have only seen with uneducated eyes, and therefore may have formed conclusions very inconsistent with the primitive theory.

THE OLDEST TREE IN THE WORLD.

Taking my cue from the said moral, please permit me to point out that the paragraph in your export edition for May, upon the "Oldest Historical Tree in the World," which is therein stated to be in the Burmese city Amerhapoora, is probably in error; for I suspect the tree alluded to is the one now to be seen in the ruined Ceylon city Anuradhapura, founded about 500 B.C., and the Annurogramum of Ptolemy. This tree is called in Singhalese, sri-maha Bodin wahansa (the very sacred Bo tree), and is reputed to be a branch of the identical Bo tree, *Ficus Religioso*, under the shade of which Gatama attained the Buddhship.

Its miraculous transference, first from the parent tree without human interference, and then from India to Ceylon, accompanied by a priestess of Buddhism (Sanyhamitta), and a bevy of young maidens, at the request of King Dewanapiya Tissa, B.C. 288, is graphically and most circumstantially described in the Mahawansa (Great History) of the Singhalese; accordingly its size is a matter of record, and its conservancy has been such an object of solicitude to the Singhalese, throughout the varied and trying vicissitudes that people have experienced through successive ages, that there can be no doubt about its identity.

The tree is surrounded by a raised stone and brick structure about 18 feet high, completely enveloping the lower trunk and having a broad platform top surrounded by a parapet and accessible by a flight of stone steps; and one must confess that notwithstanding its great antiquity and interesting history, the tree, as a specimen of arboriculture, is a ragged old fraud, whereas one of its offspring, called a "chip of the old block," of which there are many growing near, is immensely large and of great beauty.

W. MOREY.

Colombo, September 8, 1883.

EARLY BRONZE IMPLEMENTS.

THE origin of bronze is a debated point; it would appear that native copper in the rocks early attracted the attention of men, as gold has, by its brilliant appearance, but that for some time it was not used because of the difficulty of smelting and working it. An accident perhaps taught the early metallurgists that by the use of a particular ore (the oxide of tin) the fusion was more easily accomplished, and that there resulted a new metal harder and tougher than the original copper, *i. e.*, bronze. Later the art of separating tin by itself was learned, and then followed the preparation of various sorts of bronzes by the varying admixture of different amounts of copper and tin.

In Egypt, Greece, and France the arms and implements of bronze show a uniform composition; they contain 12 per cent. of tin. But at Realon in the High Alps a veritable outfit of a traveling merchant has been found where the analysis indicates 18 per cent. of tin.

The makers of these objects employed three methods of casting; by the first they poured the alloy into the moulds of stone or of metal composed of two parts. Some of these moulds have been found. The seam or raised crest at the line of junction was beaten down by hammering. This process was seldom used, since two objects of bronze entirely alike were infrequent, and the form of the objects moulded presented difficulties by this method.

The second method consisted in making a wooden model or one of some other resisting material; it was squeezed into a bed of fine sand inclosed in a frame of wood in order to obtain the mould. This process demanded two moulds for its completion, and had the advantage of dispensing with permanent forms. Numerous objects have been cast in this manner in which the line of junction is not regularly repeated. The last method used was by means of wax, in which case a model of wax was made which was inclosed in clay mingled with cow-dung, or with some other combustible material, so that when fired the mixture became porous. Then the whole was heated, the wax melted, and permitted to flow out by openings, through which afterward the molten metal was introduced, filling up the form previously occupied by the wax. In fact, upon old bronze objects finger marks have been detected which were made upon the original soft wax; sometimes also the wax has ignited and left upon the interior walls of the mould a carbonaceous deposit which has been reproduced upon the bronze tool or ornament. Frequently projections of the metal appear, which have been hammered down. These arose from the alloy finding its way into small holes in the mould.

Soldering was unknown to the ancients, and they repaired their broken implements with rivets. These holes for riveting, and those for fastening the swords, etc., to their handles, were formed in the moulds, showing they did not possess the means of perforating bronze.

The ancients, however, understood a process for softening bronze which was afterward forgotten. The chemist Darcet at the end of the last century showed first that pure copper heated to redness and plunged into cold water does not change its nature, and is neither softened nor hardened sensibly; secondly, that the various bronzes in which the tin attains a proportion less than 30 per cent., heated to redness and cooled in the air, become hard and brittle; thirdly, that the same bronzes heated to redness and plunged in cold water are sensibly softened, so much so as to permit their being worked on a lathe, their irregularities repaired, flattened under the hammer, sharpened with a file, and polished. It seems probable then that early men gave this last temper to agricultural implements which should be tough; that weapons were restored to hardness by a second heating and a slow cooling in the air.

There was yet another art known in prehistoric times connected with bronze which was rediscovered by the Alexandrine engineers, lost again, and recently introduced into Europe by Eastern travelers. It is the art of making bronze flexible. From the engineer Philon, who lived in the 2d century before our era, we learn that springs were made of metallic bands 12 fingers long, 2 fingers wide, and $\frac{1}{12}$ of a finger thick. They were made of red copper, well prepared, purified by repeated smeltings, and then alloyed with 23 per cent. of tin, itself thoroughly pure. On coming from the mould the bands were flattened cold for a long time, giving them a uniform thickness and the dimensions given above. Then they were given a slight curvature around a cylinder of wood, and then joined two by two, their ends filed, and united by rivets. The bands obtained their strength from the bronze employed, it being pure, white, strong, and elastic. The hammering hardened the fibers and made them resistant, but this hardening was superficial and inclosed between two dense surfaces was a softer interior filling.—*A. De Rochas, in Revue Scientifique.*

ASSAYING COPPER.

To the Editor of the Scientific American:

There is no fire assay which demands so much skill as that of copper, and the inaccuracy of dry copper assays is notorious, the Cornish assay, which is exceedingly troublesome, giving a result 20 to 40 per cent. under the true one. So wet copper assays, either by the volumetric or the colorimetric methods, are generally used.

I have devised the following colorimetric method, which is simpler, quicker, and more direct than any heretofore used, and requires no calculations.

There are needed an assay balance sensitive to $\frac{1}{10}$ mg., two small beakers, two porcelain capsules of about one inch diameter and two graduated and calibrated tubes, graduated to 100.

The unit of graduation makes no difference. It may be cubic centimeters, or eighths or sixteenths of an inch, or a chance unit. It makes no difference. Temporary tubes may be made by any one as follows: Take two tubes of equal diameter $\frac{5}{8}$ or $\frac{3}{4}$ inch caliber and about 16 to 20 inches long. Grind the ends square on a grindstone, and cement one end of each on to a square of glass with very thick shellac varnish. Then on two narrow slips of paper draw with pen and ink two identical scales of 100 divisions; paste these scales on the tubes, beginning at the bottom.

The proper amount of copper and of copper ore to be used in the assay is about four centigrammes. More gives too intense a blue in the solutions. Put about four centigrammes of the finest copper wire in one pan of the assay balance, and bring the balance into equilibrium with the powdered ore in the other pan—equal weights of each.

Now dissolve the copper wire in fuming nitric acid in one capsule, and dissolve the ore in nitric acid or aqua regia in the other. When they are dissolved add a little water and pour into the two beakers, and add ammonia to each to excess, as usual in colorimetric tests of copper.

Now pour the solution of the copper wire into one of the tubes, and immediately add sufficient water to bring it up to the 100 mark at the top of the scale, and shake up. The resulting color of course represents 100 per cent. of copper. Now pour the ore solution into the other tube and compare the colors; add water very cautiously to the ore tube with shaking until the colors exactly correspond. Then the reading of the surface of the blue liquid on the scale of the ore tube is the percentage. If it fills the tube to 62, the ore contains 62 per cent. of copper. With poor copper ores you must be cautious about the first addition of water, or you may get too weak a color in the ore tube at the start, in which case the assay is lost, unless you want to throw out half the solution in the copper tube, and replace it with water; then you halve the reading on the ore tube. Interfering metals must be removed in advance.

ANDREW VAN BIBBER.

Cincinnati, O., Oct. 4, 1883.

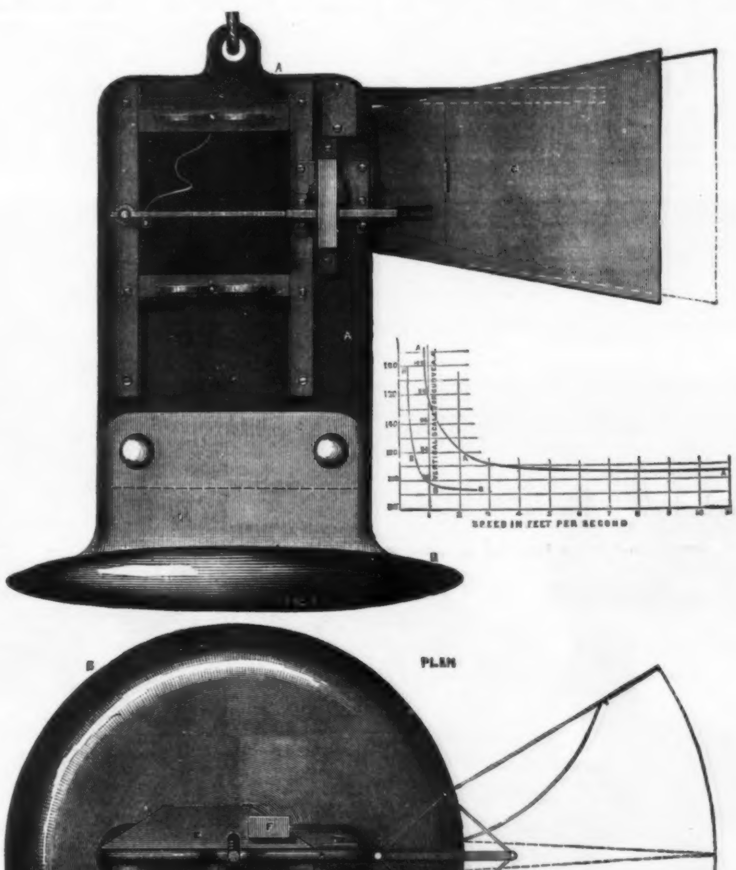
IMPROVED CURRENT METERS AND MODE OF TAKING SUB-SURFACE OBSERVATIONS.*

By Professor H. S. HELE SHAW.

THE difficulties in the way of taking current-meter observations on sub-surface velocities in a river channel or tidal estuary are well known, and have led to the abandonment of that method by one or two of the highest authorities and most extensive experimenters. These difficulties fall under two heads: (1) The construction of a suitable meter, and the determination of its constants. (2) The mode of using it to obtain sub-surface velocities. The meters which are by far the most generally used have a revolving screw or fan, the number of turns of which in a given time affords a measure of the speed of the current. Instruments of this class have been brought to a tolerable state of perfection, and by means of various devices by which electric communication is established between the screw and the observer at the surface very satisfactory results have been attained. The mode of using this kind of meter at comparatively small depths and moderate velocities is to employ a rod of wood or metal, or an iron tube, by which it is held in the required position. Where the channel is deep and the current swift this method requires either elaborate raft or other arrangements, or the assistance of several men. If, as is very often the case, the channel is a tidal and navigable one, and interruptions are frequent, the taking of a series of observations by these means is a toilsome and laborious task. It is under the latter conditions that the author is at present engaged in taking a series of observations, and this paper contains a brief account of certain instruments employed, and the mode of using them. One object of the experiments was, to obtain the velocities at one point near the bottom during the whole rise and fall of the tide. To avoid the labor of frequent observations and the continued attendance above the point with a boat, which would have been otherwise necessary, the plan was tried of supporting the meter at the bottom of the channel instead of suspending it from above. This was done by driving an iron bar into the river bed at low water, and screwing the meter to it in its right position, and at such a depth as to avoid all danger to or from passing shipping. A self-recording meter was necessary, and the one illustrated was employed. The instrument in its original form has been elsewhere described by the author,† but the present form has a most important modification in the recording apparatus. Into the watertight barrel a spindle passes, which is turned once for fifty revolutions of the screw. At every revolution of the spindle a needle is raised which flies back under the action of a spring and punctures a tinfoil sheet, a specimen of which was shown. This sheet is wrapped round a drum, which is turned uniformly by clockwork once in an hour, so that not only can the velocity be determined by the number of dots in a given space, but also the time at which the particular velocity occurred. In order to use the whole surface of the foil, the piece which carries the marking needle and spring moves along by a slow screw, so that the instrument will record continuously for as long as twelve hours. There is yet another point, viz., that in order to record the time when the tide turns another needle is used, which records the motion in the opposite direction, and the marks on the foil slant the opposite way. The special objection which was found to hold with this arrangement is the fact that weeds and drift moving along near the bottom get entangled in the fan. In this case there is nothing in the record to enable the cause of the consequent alteration to be detected with certainty. Moreover, the bearings of the fan need frequent examination in the muddy waters in which the instrument was employed, and this it was, of course, impossible to secure. For this reason the author afterward employed at all depths the method, which has recently been used by Professor Unwin and other observers, of suspending the meter with a weight. A suitable tail causes the meter to take its proper position in the current, and it can be easily hauled up for inspection. The author was led to conclude that for the above reasons no meter with a revolving screw could be left to work by itself, at any rate under these conditions. Also that the method of suspension by a rope is by far the easiest and most rapid mode of experimenting.

There are however at least three serious objections inherent in screw current meters: (1) The speed of the fan at even moderate velocities is not proportional to the speed of the water. (2) It is impossible to maintain the same conditions of friction for more than a very short time of working, especially in impure water. (3) They stop altogether at low velocities. The first is made clear by the curve, AA, in the diagram, which shows the rating of a meter by Mr. R. E. Froude at the Admiralty Experimenting Works, Torquay. The abscissæ in this figure represent velocities, the ordinates give the different distances moved through for eighty revolutions at any given velocity. It will be seen that the vertical scale of AA is a very open one. The curve, BB, represents the same series of experiments as AA, drawn to a closer vertical scale; these curves are difficult to obtain. They show that with the kind of meter in question it is impossible to determine from the number of revolutions in a given time the exact speed of the current, should that speed meanwhile vary to any extent. The curves also show clearly the force of the third objection, the meter stopping altogether when the current velocity is as much as one-third of a foot per second. The second objection is one which is often overlooked in tolerably clean water, but which nevertheless exists, while in muddy water it very soon becomes felt. Mr. R. Gordon has recently drawn attention to it* as occurring in his experiments in the Irrawaddy. In the Severn and confluent waters the futility of elaborate previous testing has been made painfully apparent to the author.

It was with a view of overcoming the foregoing objections that the author contrived the meter shown in Figs. 1 and 2. This belongs to the class of instruments in which the statical effect of the current is made to record its velocity. Hitherto these instruments have necessitated some direct mode of communication with the surface, since with the constant fluctuations in velocity an average record extending over some period of time, however short, must be obtained. In other words, a mere instantaneous observation—giving, of course, the maximum effect—would not be reliable. Such instruments are the Pitot tube and the Darcy gauge, or the torsion meter of M. Perodil, but these are not suitable under the conditions in question. The instrument shown in Figs. 1 and 2 may be described as a flat plate of steel, AA, to which is rigidly attached a weight, B, of 45 lb. of lead. The edge of the plate meets the current, while the lead is shaped to present as little resistance to the flow as possible. Behind the plate, and in the position usually occupied by the tail or vane of a screw meter, there are hinged two nearly flat plates or wings, CC. These plates tend to open under the action of springs, but are kept more or less shut by the current acting in the direction shown in the figure. Their position is recorded by means of a style, D, which scratches a sheet of white paraffine paper having a blackened surface. It is thus unaffected by the water, and a clear white line is produced. The paraffine paper is fixed to a plate which is moved at right angles to the direction of the style by clockwork, E, and thus a continuous record of the rate of motion of the water is obtained. The clockwork is arranged to start when the meter passes beneath the surface of the water by means of a float, F, which acts on the escapement, and to stop automatically at any required time in the travel of the plate. The mode of taking observations is as follows: The meter is lowered from a boat to the required depth, and the time noted. If required it may remain simply suspended there, and a record may be obtained for as long as five minutes, when it is raised to the surface, the paper removed, and a fresh piece inserted. It is clear that a series of observations may rapidly be taken at different depths without raising the meter to the surface by merely noting the time at which the changes in position are made, and for which the meter remains at each point. A curve of vertical velocities may be directly obtained by lowering the meter from the surface to the bottom. There are no doubt certain points of superiority in the screw meter, and one is in the delicacy of observation to be obtained by taking with a very light and quickly turning fan the number of revolutions in very short periods of time. The following most important advantages may, however, be fairly claimed for the new instrument: (1) A direct record of actual current speeds. (2) Capability of obtaining records down to the velocity of zero. This is what no screw meter can possibly give. (3) No appreciable liability to alteration of constants either by fouling of bearings or by varying states of lubrication. (4) Reduced liability to the entanglements of weeds or floating matter by the flat plates—which are presented in a slanting direction—as compared with that in the case of a revolving screw. (5) A simple and ready means of verifying constants by merely hanging weights from a suitable point in the wings. (6) Decreasing resistance with increase of velocity by reason of the closing together of the plates or wings. This is a point of great importance with a suspended or swinging meter. (7) Continuous historical record giving the velocity at every instant without communication with the surface. It should be stated in conclusion that the meter is not the subject of a patent, and may be made at comparatively small cost.



PROFESSOR HELE SHAW'S CURRENT METER.

*A paper read before the British Association at Southport.

† "Min. Proc. Inst. C.E.," vol. lxix., p. 399.

* "Min. Proc. Inst. C.E.," vol. lxxi., p. 71.

THE CANNON, THE STEAM ENGINE, MAN, AND THE INSECT CONSIDERED AS MECHANICAL MOTORS.

UNDER the above title, we give a *résumé* of some very curious and interesting information published in a recent work of Mr. E. Jouffret, entitled "Introduction to the Theory of Energy."

These examples, which are submitted in a simple and clear way, are well calculated for disseminating a knowledge of the phenomena of conservation and transformation of energy, by presenting them under a concrete form accessible to all those who are not making a special and continued study of them.

A 100 ton cannon (Italian model of 1879) costs 400,000 francs. It requires a 250 kilogramme charge of powder and throws a projectile weighing 917 kilogrammes, with an initial velocity, at the mouth of the cannon, of 523 meters per second.

The energy possessed by the projectile, in the form of live power, is 12,772,000 kilogrammeters.

The energy represented by one kilogramme of powder is, according to Noble and Abel, 300,000 kilogrammeters, or 75,000,000 kilogrammeters for the charge of 250 kilogrammes.

The *cannon*, considered as a machine, converts then into work *seventeen per cent.* of the total energy of the combustion of the powder. This figure is higher than that furnished by the best steam engines, as these convert into work less than ten per cent. of the total energy represented by the coal.

It is the animal machine in which the performance is the highest, and this fact may be established in a particular case, as follows:

According to the *Guide Joanne*, the ascent of Mont Blanc, starting from Chamounix, is effected in seventeen hours, resting spells not included. The difference of level is 3,760 meters. A person ascending, who has a mean weight of 70 kilogrammes, produces, then, in order to rise, a work of $3{,}760 \times 70 = 263{,}000$ kilogrammeters. This work is borrowed from the heat that the carbon and hydrogen contained in the food eaten disengage upon being burned in the lungs. For the sake of simplicity, if we reduce the entire energy to a combustion of carbon, and recall that a kilogramme of the latter furnishes 3,000,000 kilogrammeters, we find that the 263,000 kilogrammeters represented by the ascent correspond to a consumption of 94 grammes of coal—a consumption that comes to be added to the normal rations necessary for the operation of the organs during a state of rest. Such consumption is 8·35 grammes per hour, or 142 grammes for the seventeen hours. The total consumption of coal is 256 grammes, representing 708,000 kilogrammeters. The performance, then, is:

$$\frac{263{,}000}{708{,}000} = 37 \text{ per cent.}$$

The performance of the human machine drops to 21 per cent. when we consider a period of twenty-four hours composed of ten hours of work and fourteen of rest, and a mean daily work of 280,000 kilogrammeters.

The cannon, considered as a machine, is incomparably superior to the steam engine as regards the time necessary to produce a given quantity of mechanical work.

Thus, for example, the 100 ton cannon develops in *one-hundredth of a second* a quantity of work equal to that which would be yielded by a 47 horse power steam engine *in one hour*. A man of average strength is still lighter than an ordinary steam engine of equal power, but he is much inferior to the other animals of creation, and particularly to insects.

Thus, for example, the libellula, which is capable, without apparent fatigue, of following a train of cars for several hours, giving its wings during this whole time some thousands of backward and forward motions per second, is a hundred times lighter than a steam engine capable of producing an equivalent work.

This is what renders the problem of aerial locomotion so difficult, and, as Mr. Hirn says, it explains why we can fly in imagination only.—*La Nature.*

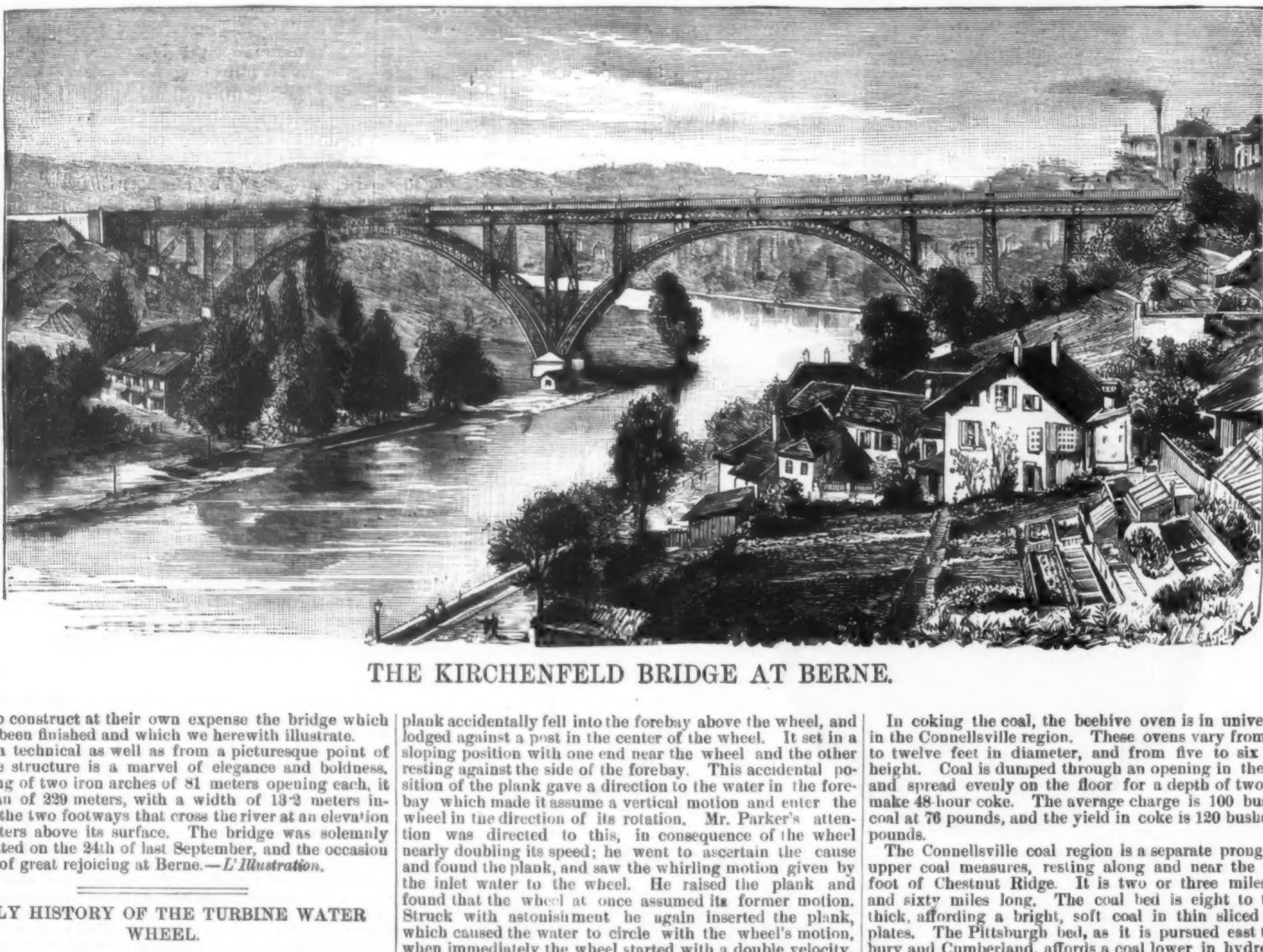
THE KIRCHENFELD BRIDGE, AT BERNE, SWITZERLAND.

BERNE, the capital of the Swiss Confederation, is situated upon a long and quite elevated peninsula, surrounded on three sides by the river Aar. Such a situation has been opposed to the material development of the city, and the latter has, during recent years, been enabled to expand, in fact, only under abnormal conditions. To the north, the construction of the Central Railway's tubular bridge permitted of the establishment of two new wards. One of these, which is quite extensive, is called "La Lorraine," and is designed for the laboring population. The other, called "Le Rabbenthal," is completely finished. It consists only of pretty villas, one above another, on the sides of the hill at whose summit is found the Schnalli, which is so well known to all tourists.

For more than fifty years, different projects have been devised for bringing about a development of the city toward the south; but the difficulties in the way of this have been multiple, since it was a question of connecting two heights that were separated from one another by more than 500 meters distance, and with an elevation of 35 meters above the river, in order to put the center of the old city in communication with the opposite plateau—that of Kirchenfeld, an immense extent of ground only utilized for agricultural purposes.

Finally, in 1881, a solution of the problem was found, and the building of a bridge to unite the two hills was decided upon. The city ceded, for the price of 425,000 francs, 80 hectares of land to a company of English capitalists, who agreed to construct at their own expense the bridge which has just been finished and which we herewith illustrate.

From a technical as well as from a picturesque point of view, the structure is a marvel of elegance and boldness. Consisting of two iron arches of 81 meters opening each, it has a span of 229 meters, with a width of 13·2 meters including the two footways that cross the river at an elevation of 35 meters above its surface. The bridge was solemnly inaugurated on the 24th of last September, and the occasion was one of great rejoicing at Berne.—*L'Illustration.*



THE KIRCHENFELD BRIDGE AT BERNE.

EARLY HISTORY OF THE TURBINE WATER WHEEL.

ONE of the first, if not the first, patents granted by our laws for a water wheel was to James Cobb, of New Jersey, but whether it was a turbine or not the specification does not say. The patent was granted in 1719, and the next one granted for an improvement of this nature was to J. Farman, of Oswego, N. Y., in 1808. In 1829 Mr. Parker, of Ohio, obtained a patent for a "percussion and reaction wheel," and from this may be dated the first improvement in water wheels. Oliver Evans in his work on milling, published in 1795, alludes to an improvement made on the Barker wheel by James Rumsey, but does not state in what this improvement consisted. Subsequently, Mr. Whitelaw, of Glasgow, attempted an improvement on the Parker wheel by bending the two arms in the form of the letter S. Glynn in his "Power of Water" alludes to this, and adds: "The invention of the turbine, properly so called, belongs to Mr. Fourneyron, and in its present form it generally consists of a horizontal water wheel in the center of which the water enters and diverges in every direction; it enters every bucket at once, and escapes at the circumference."

The offer of 6,000 francs by the French government to any person who should succeed in making and arranging a turbine that would give out no less than 70 per cent. of the power of water, stimulated Mr. Fourneyron to action. After experimenting for seven years he succeeded in drawing the government prize. It appears that the brothers Parker in this country were experimenting with a reaction wheel about the same time as Fourneyron, but completed their improvement before the latter, and it is claimed by many that they were the original inventors of the turbine.

The only water wheels used in the United States up to the year 1830 were the undershot, overshot, breast wheel, Rumsey and flutter wheels, each of which was constructed according to the peculiar notions entertained by the different millwrights who were employed.

It is singular that the invention of Parker brothers was the result of an accident in the experiments which were in progress from 1824 to 1830, the issues of which have revolutionized the application of turbine water wheels. The Parker brothers, residing then in Muskingum County, Ohio, erected a mill on Hill Creek, a few miles above its junction with the Muskingum River. They put in a common flutter wheel, but as their fall was only about six feet they were considerably annoyed by frequent stoppages by back water. The failure of this wheel caused the brothers Parker to inquire after one that would be more efficient when exposed to back water pressure. The Rumsey wheel, then in considerable use in Ohio, and known as a back water wheel, was hung horizontally upon a vertical shaft, and was peculiarly adapted for driving an up-and-down saw. This, the Parker brothers concluded, was not suitable for their mill, and after considerable reflection they devised a new motor consisting of six reaction wheels set in pairs, hung vertically on a horizontal shaft, to which the water was admitted in a direction contrary to the wheel's motion. The consequence was the wheels scarcely exercised any power, and it was with the utmost difficulty they could be got to run. Unable to discover the error, they concluded to give up the saw mill. They subsequently erected a grist mill in the same place and put in a Rumsey reaction wheel on a vertical shaft. They adopted for this wheel improved buckets of cast iron plates bolted between the rims, the bottom being a wooden disk fastened to the shaft. This wheel was run directly under the forebay, from which the water passed into the wheel from a round orifice in the bottom, corresponding in size with the inner circle of the top rim of the wheel. It happened that the head-gates leaked enough of water when shut, to cause the wheel to run. While erecting the gearing and putting in the mill stones, a plank accidentally fell into the forebay above the wheel, and lodged against a post in the center of the wheel. It set in a sloping position with one end near the wheel and the other resting against the side of the forebay. This accidental position of the plank gave a direction to the water in the forebay which made it assume a vertical motion and enter the wheel in the direction of its rotation. Mr. Parker's attention was directed to this, in consequence of the wheel nearly doubling its speed; he went to ascertain the cause and found the plank, and saw the whirling motion given by the inlet water to the wheel. He raised the plank and found that the wheel at once assumed its former motion. Struck with astonishment he again inserted the plank, which caused the water to circle with the wheel's motion, when immediately the wheel started with a double velocity. He then placed the plank in a contrary position, so as to give a direction to the water contrary to the rotation of wheel. The result was that the wheel immediately stopped, and so remained until the plank was taken away, when it resumed and ran as before. After consulting for some time, the Messrs. Parker arranged the guides of their wheels so as to direct the water downward with a vertical motion, coinciding with the rotary direction of the wheel. This wheel operated in a very superior manner, doing more work than any wheel of the kind had ever been known to do before, so that this peculiar accident was the cause of the first great step in the improvement of reaction wheels. After experimenting for some time upon this wheel, their knowledge became considerably extended, and soon they were enabled to calculate with more certainty the form and size of issues in proportion to the quantity of water and height of fall. In Oct., 1830, a patent was obtained by the inventors for their wheel. The claims upon which this patent was granted were: 1. The compound vertical and percussion reaction wheel, by making the buckets as thin as they can be safely made and the rim no wider than is sufficient to cover them. 2. The spout that directs the water into the wheel and the spiral terminations of the spout between the cylinders. 3. The rim and planks that form the apertures into the wheel, and the manner of forming the aperture. The patentees succeeded to a certain extent in introducing their wheel to the public, but found a great hinderance to the general application of the wheel in the rapid wearing of the steps. This evil seemed insurmountable for a long time, but was at length removed by admitting the water from the lower sides of the wheels.—*Milling World.*

COKE.

COKE is a manufactured article, and the selling price at the ovens is largely represented by wages paid. In the United States Census for 1880, it appears that 2,752,475 tons of coke had been produced from 4,360,110 tons of coal, in the fiscal year ending with May 31, 1880. The value of the raw coal was stated to have been $2,761,657, and of the coke $5,365,489. Values at that time were higher than at present. In this Census report nine States are set down as having coke ovens within their borders; Pennsylvania was set down as having made 2,317,149 net tons of coke. For the year 1882 we have returns showing that 3,250,000 tons of coke were made in the State of Pennsylvania. As a matter of fact, the counties of Fayette and Westmoreland produced the bulk of the coke, or say 2,840,000 tons in the last calendar year. The returns from a typical establishment in Fayette County show:

The number of days worked were.........	303
The persons employed were...............	391
The number of coke ovens was............	500
There was produced of coke, in net tons...	190,482
From a coal consumption of (tons)........	277,890
The wages paid amounted to...............	$209,482

Coke from the seam of coal found in the Connellsville basin, in Fayette and Westmoreland counties, Pennsylvania, stands as the typical coke of this country, and every operator in coal which has coking qualities, endeavors to show by analysis that it equals or compares favorably with the Connellsville product. Coke, to be entitled to merit and value, must possess hardness of body or cell walls, not density, for dense cokes are frequently soft or punky, while hard cokes generally afford a well developed cell structure. These two physical properties, hardness and full cellular spaces, are correlated, just as softness and density are associated.

In coking the coal, the beehive oven is in universal use in the Connellsville region. These ovens vary from eleven to twelve feet in diameter, and from five to six feet in height. Coal is dumped through an opening in the crown, and spread evenly on the floor for a depth of two feet, to make 48-hour coke. The average charge is 100 bushels of coal at 76 pounds, and the yield in coke is 120 bushels at 40 pounds.

The Connellsville coal region is a separate prong of the upper coal measures, resting along and near the western foot of Chestnut Ridge. It is two or three miles broad and sixty miles long. The coal bed is eight to ten feet thick, affording a bright, soft coal in thin sliced vertical plates. The Pittsburgh bed, as it is pursued east to Salisbury and Cumberland, affords a coal lower in hydrogenous matter. Westward the excess of pitchy matter in the coal leads to an inflated physical structure in coke. A carefully prepared coke, alike all through, is most desirable for regular work in blast furnaces. This result can be best obtained from coal similar to the Connellsville, inheriting a liberal ratio of hydrogenous matter to assure full oven heat and thorough coking in every part of the charge.

A few chemical analyses are given below of cokes from various districts:

	Fixed Carbon.	Moisture.	Ash.	Sulph.	Phos.	V. M.
Connellsville, A. S. McCreath...	89·57	0·80	9·11	·82	·014	·460
New River, W. Va., J. B. Britton	92·18	0·11	6·68	6·18	·027	·350
Broad Top, T. T. Morell...	89·28	....	8·66	1·06	....	....
Clearfield, B. Garrett & Blair...	89·86	0·54	9·41	....	....	·667
Illinois, T. T. Morell.	89·77	0·12	9·58	0·93	·033	....
Tennessee, Univ. of Cincinnati..	94·56	....	4·65	0·79	·008	....
Colorado, "El Moro"...........	87·47	....	10·68	0·85	....	....

This statement shows the chemical analysis of the various cokes to be very similar in some respects, but when we take their physical properties, none inherit so many essential requisites in equal degree with the coke made in the Connellsville district—in cellular structure, in hardness, and in the height of furnace charge that it will bear before crushing. This we have on the authority of Mr. John Fulton, of the Cambria Iron Works, at Johnstown, Pennsylvania.

Coke is used in the blast furnace, and gives a larger yield of pig metal than does the use of anthracite coal. It is used in foundries, east and west, and the 72-hour coke is

preferred for this work. In crushed coke, four sizes, as of egg, stove, small stove, and nut, are made, for use by manufacturers of safes, chains, axles, shovels, files, bolts, agricultural implements, brass foundries, maltsters, for blacksmithing and by steel manufacturers. It is also used for domestic purposes in grates and base-burning stoves.

At present there are some 10,171 ovens in the Connellsville coking region of Pennsylvania; it is a growing industry, and therefore the B. & O., the Pennsylvania, and the Vanderbilt lines are each anxious to secure a share of this tonnage. Of the location of other coke makers in Pennsylvania the book noticed elsewhere will give the details. Prices of coke are quoted at many places by our trade reports. For the distances traversed the prices are not high. We have given more particular attention to the Connellsville because it is the most important district. On the New River, in West Virginia, on the line of the C. & O. Railway, coke is being made quite largely, as also in Tennessee, in Colorado, in Illinois, and in Alabama. In the Reynoldsville district and in the Blossburg district of the Pennsylvania soft coal region, we find the production of coke, as a commodity for sale, to the greatest extent outside of the Connellsville district.

There is a tendency toward the control of the output of the Connellsville coke, and of the details and progress of this matter our readers have been kept fully posted.

Connellsville coke is quoted at $1.00 per ton at the ovens for furnace, $1.25 per ton for foundry, and crushed coke at $1.75 per ton.—*Coal Trade Journal.*

A NEW SOLAR REGULATOR.

AMATEURS and owners of country seats who like to consult the hour by the sun, and are satisfied with but relative accuracy, have long needed an apparatus that had a neat appearance externally and was easy of management. This want is now supplied by the solar regulator, an apparatus constructed according to data furnished by its inventor, Mr. Corneloup, a manufacturer of clocks.

A description of the apparatus will be easily understood by the aid of the annexed figure, which represents it half the actual size.

Upon a pillar carried by a quadrangular base there is mounted a support which has its extremities bent at right angles, and which revolves in a vertical plane and on a center at which ends the apex of a graduated sector. This latter

A NEW SOLAR REGULATOR.

gives the measurement of the inclinations that the support can take, and which should always correspond to the latitude of the place. The sector, having been brought to the proper point, is fixed by means of an adjusting screw. At the base of the support there is fixed a small case which is provided with a dial and hands.

The style, and the plate upon which the noon line is traced, are independent. The plate pivots between the two upturned extremities of the support. Upon the prolongation of the lower pivot, which enters the dial case, there is adjusted a pinion which, through the intermedium of wheel work, causes the hands to revolve.

A compass fixed on the base of the apparatus serves to place it in proper position. The instrument is regulated when the aperture in the style, the solar noon line, and noon as shown by the hands on the dial are exactly in the same vertical plane.

The instrument having been regulated, it will be only necessary to incline the style to the right or left so as to bring the luminous point upon the noon line; and, as the hands will follow its motion, the hour will be read upon the dial.

While traveling, the owner may regulate the apparatus by the aid of a good watch, having seconds hands, which has been set by observatory time, or by the aid of a good chronometer. The instructions that accompany the instrument indicate the inclination to be given the sector to make it correspond with the latitude.

What will bring this little apparatus into favor with amateurs is the fact that, unlike the sun-dial, which is always fixed, it may easily change place and the hour be read upon it just as is done with a watch.—*La Nature.*

THE OIL INTEREST OF SOUTHERN CALIFORNIA.

FEW persons who have not given especial attention to the oil interest in this portion of the State realize its importance. A casual trip only through the region in which the oil developments are being made gives no idea of the results already accomplished. Take the Newhall or Pico district, for instance. The oil output of this district has averaged during the last year more than 1,000 barrels per day, of an average value of $2 per barrel, or in round numbers 365,000 barrels per year, of the total valuation of over $700,000. All this has been derived from a very limited area of territory, not over 1,000 acres all told.

So great has been the success of the parties who have inaugurated this enterprise at Pico, that they have determined to enlarge to an enormous extent their field of operation, and take in the whole of the Santa Clara Valley, containing an oil area of many hundreds of thousands of acres. Already have they formed corporations for pipe lines down the valley to Ventura, and the pipes are laid from Santa Paula down to the sea. In addition, there are piled up at Newhall large stacks of pipe, which would seem to be more than enough to pipe all the way from Newhall to Santa Paula and connect the wells already productive with the sea.

Companies of parties from Pennsylvania have been formed for putting down additional wells, and derricks are rising in all directions on the mountain sides of the Santa Clara. There are also piled up at Newhall large piles of pipe, six, seven, and eight inches in diameter, to be used in casing wells now being put down, or to be put down in the immediate future. The indications now are that more than one hundred wells will be put down in this valley alone in the next six months, and the output more than doubled.

Already is this the second oil-producing field in this country, and with the energy and pluck now being shown, it will not be many years before Pennsylvania, so long the oil monarch of the world, will be obliged to look to its laurels.

This increased development can be of incalculable value to our sister county, Ventura, and to its principal port, San Buenaventura. With a million or more of dollars flowing into it from its oil exports, with the increased valuation given to its productions by a home market established by the oil industry, Ventura County must, in the immediate future, receive a boom which will add a greatly increased value to its lands and prosperity to its people.

Without any jealousy of Ventura and its riches, we can call attention to the fact that the surface indications of oil in Santa Barbara County are every whit as good as those in Ventura, and that beyond question oil lies within the limits of this county, only needing stirring activity and business energy to bring it forth. Who will inaugurate this enterprise and put down a well, not 200 feet deep, but 2,000 feet, if necessary? There may be risk, but if successful the result will more than compensate for the risk run.—*Santa Barbara Independent.*

COLLODIO-CHLORIDE PAPER.

IN a glass beaker dissolve eight grammes of nitrate of silver in six grammes of distilled water by heat; drop this solution into a bottle containing 135 c. c. of alcohol. In cold weather it is better to put the bottle in a vessel containing warm water; then add eight grammes of soluble cotton, and, after thorough shaking, 160 c. c. of ether. On further shaking a grayish-white collodion will form itself. In another bottle dissolve one gramme of chloride of lithium in thirty-five c. c. of alcohol, together with one gramme of tartaric acid. This solution is to be dropped into the argentiferous collodion, which must be shaken all the while. This collodion will keep for any time if preserved in a well-corked black bottle or in a fitting dark cover.

Have a thin piece of wood, same size as the paper that is to be coated, with a knob fastened at the under side; pin the lichtdruck paper on it at three of the corners, so that the right and lower edge project a little over the wood (this will cause the collodion not to run under the paper), and the left edge of the paper may be turned up a little; but this will not be found necessary after some practice. Now hold the wood with the left hand by the handle, as you would take a glass plate fixed to a pneumatic plate-holder, and pour the collodio-chloride upon the paper just as you would coat a glass plate with collodion. Having returned the surplus of the collodion to the bottle, take the pins away and hang up the paper to dry. The paper will keep for several weeks.

Some prefer to use a pink-colored lichtdruck paper, whose color will obliterate any trace of yellow that might form by keeping it for a longer period.

As to the printing: it must be done in the shade, and weak negatives are better covered by thin, white paper during printing. Toning may be done in an old gold bath that is not too strong. German photographers prefer the following: Make two stock solutions—one of one gramme of chloride of gold in 1,500 c. c. of water; and one of twenty grammes of sulphocyanide of potassium, three grammes of hyposulphite of soda, and one gramme of carbonate of soda in 1,500 c. c. of water. Before going to work mix equal parts of these solutions, but be sure to pour the gold into the sulphocyanide solution, not *vice versa.*

After having washed the prints in water three times changed put them in the gold bath. If it work too quickly it will give gray tones. I usually dilute it with water that it may act more strongly; and for weak negatives I pass the prints before toning through a two-per-cent. solution of sulphocyanide of potassium, the prints becoming of a much richer tone by this. Fix in a five-per-cent. solution of hyposulphite of soda (five minutes will be sufficient), and wash for one hour in water frequently changed.

Now, to make the prints look like enameled silver prints: clean a sheet of glass, a little larger than the print, and rub it with French chalk; after dusting it off with a brush, lay the print, film side down, on the glasses; put some filtering-paper upon it, and go over it with the hand to make the print adhere and to remove air-bubbles. Allow it to dry, and the print will come away with a very high gloss. A part of this it will lose on mounting; but if you mount it at the corners only, as is sometimes done with enameled prints, it will retain it all.—*E. Liesegang, Ph.D., Br. Jour. of Photo.*

THE TONIC SOL-FA METHOD OF TEACHING TO SING.

By PROF. C. F. KROEH, of the Stevens Institute of Technology.

WITHOUT claiming to speak with authority on musical matters in general, I may be permitted to say a few words with regard to the educational aspects of a method which has interested me very much.

The scarcity of vocalists that can read at sight suggests the thought that there must be some fundamental error in the prevailing methods of instruction. There is nothing surprising in this; for the same phenomenon may be observed in the teaching of languages—our own as well as foreign ones—and it is only within comparatively few years that the mental processes involved in learning to read and to speak have been analyzed, understood, and made available for teaching. In the same way it may be that teachers of music do not realize the necessity of understanding mental processes to enable them to impart the skill which they possess.

All the instruction books according to the old method, that have come under my observation, begin by an explanation of the cumbersome and complicated method of musical notation, which many a scholar gives up in discouragement. Here is an educational error at the outset, which all students of the art of teaching will understand at once. It is beginning with the sign instead of the thing itself. Now, it so happens that in music the "thing itself" is intangible; it consists of sounds having different characteristics and of their intervals. Any method that does not begin by cultivating the ear and inculcating the habit of forming and recalling tones and intervals can never be generally successful. The old method—and this applies to instruments as well—looks upon music as though it consisted of black spots with tails, and as though it were the learner's chief task to decipher what these spots mean in different positions under varying circumstances. I submit, that this is not *music;* nay, that it is not even a good way of *denoting* music. Yet many instructors of music seem to hold this view, or we should not hear them speak disparagingly of those who ought to be their best pupils. "They play by ear, and will never make good musicians." It seems to me that if such players do not make good musicians with reasonable efforts, the fault lies somewhere else. Everybody that has no organic defect in his auditory apparatus ought to be able to master the elements of music sufficiently to give pleasure to himself and to others; and of two learners equally diligent, the one with the better ear should accomplish his object most rapidly.

If all musical instruction—instrumental included—began with such training of the ear as would make the learner familiar with the tones and their intervals by leading him to imitate them by singing or even by whistling until he could accurately reproduce them from memory, we should find fewer people possessed of the idea that music is a mechanical thing, consisting mainly in skill in fingering, and that it is an accomplishment to strum a few tunes painfully acquired by rote.

We are living in a good age for getting rid of the ways of doing and viewing things which have come to us as a legacy from the middle ages. If the decree went forth that the present musical notation together with the Chinese characters and the English system of spelling should be abolished, we should bow in thankful submission and envy the generations to come.

It is indeed a subject for profound surprise to an unprejudiced student, how so simple a matter as the sequence of twelve definite sounds which follow each other in unvarying intervals, no matter at what pitch the first one may be chosen, could be denoted in so mysterious a way as by the present staff with its additional lines, and transposition signs. The Rev. J. C. Curwen, an English clergyman, has succeeded in inventing a more simple, natural, and successful notation for vocal music which is adapted to some extent also for instruments. Mr. Curwen's fundamental idea was that it is more advantageous to denote intervals than the absolute pitch of every note. A very satisfactory description of the system is found in the appendix of "Die Lehre von den Tonempfindungen" by Helmholtz, the greatest living physicist and highest authority in all acoustical subjects. The following is a translation of his remarks:

The Tonic Sol-Fa associations which are represented in all the large cities of England, and which numbered 150,000 members as early as 1862, designate the notes of the major scale by means of the syllables, Do, Re, Mi, Fa, So, La, Ti, Do, where Do always stands for the key-note. Their songs are not printed in notes but in ordinary type, the initials of the above syllables representing the note.

If the tonic or keynote is changed in the course of a piece of music, the new key-note is again called Do; and this is indicated by giving two names to the note at which the change occurs. By this means the relation of every note to the key-note is always brought out, while the absolute pitch is given only at the beginning of the piece. As the natural intervals are the same in all the major keys, no tempering is necessary. (By tempering the author means the adjustment of our pianos by which the 12 chromatic intervals of the octave are equalized at the expense of the purity of certain chords.) The fact that in modulating from C major to G major, the Mi of the latter corresponds exactly to the Ti of the former and the Re of the latter very nearly to the La of the former is not denoted, but it is taught later in the course.

There is no doubt that this method of denoting vocal music has the advantage of bringing out prominently what is most important in aiding the singer, namely, the relation of any given note to the key-note. Few only are gifted with an extraordinary talent for remembering the absolute pitch of notes and for finding them again, especially when other notes are sounded at the same time. Now, the ordinary notation indicates only the absolute pitch of notes, and this only for tempered instruments. Any one that has sung much at sight knows how much more easily this can be done from the piano-score, in which the harmony may be seen, than from the score for a single voice. In the former case it may easily be perceived whether the note called for is the fundamental note, the third, the fifth, or the discordant note of each chord, and the right pitch is easily found; in the latter case, the only way is to ascend and descend according to the intervals required, and trust to the accompaniment and other voices for assistance in forcing one's own voice into the proper pitch.

The Sol-Fa notation on the other hand shows directly to the initiated what a vocalist conversant with the theory of music can get from the piano score. I have convinced myself that the use of this notation enables one to learn much more easily to sing correctly from the score for one voice than from the ordinary musical notation. I have had the opportunity of hearing more than 40 children between the ages of 8 and 12 sing exercises in the public schools of London, and they astonished me by their certainty in reading the notes and by the purity of their intonation.

Helmholtz then goes on to commend the habit of singing according to the natural rather than the tempered intervals, and to state that there will be little difficulty in making the various instruments agree with the voice. The brass instruments already have the natural intervals; the string instruments can make them as easily as they can the tempered ones; there will be no difficulty in adapting the flutes, clarinets, etc.; organs have been built especially for this purpose, and the only obstacle remaining is pianos.

It would seem as though the Tonic Sol Fa method ought to recommend itself to the common sense of mankind without such high indorsement as that of Helmholtz; but there will always be found many to whom the old way has become a second nature. They have mastered it and object to a change. It is so with all innovations. The objectors are right so far as it concerns themselves—but let us give the children a chance.

THE Penobscot Indians, who have been a part of the history of Maine for 300 years, have intermarried until they have become almost white. Oldtown, the seat of their mission, has decreased from a population of 8,000 in 1695 to a mere hamlet of a few hundred souls in 1883.

LUTHER'S STATUE AT EISLEBEN.

THE statue of Luther which was unveiled Nov. 10, 1883, at the birth place of Luther, Eisleben, in the Market Square, before St. Andrew's Church, is the work of one of Germany's most celebrated sculptors, Rudolf Siemering, of Berlin. As shown in our engraving, it consists of a bronze statue of the great Reformer, which stands on a granite pedestal, on which are four bass-reliefs representing scenes from his life. Luther is represented in energetic and even dramatic pose, with his right hand raised in the act of throwing the Papal bull into the flames and his left clasping to his heart a Bible. The first of the bass-reliefs, which are rectangular in shape, with the figures in half length appearing in arched openings, represent the "Triumph of the Reformation." An angel with half-spread wings looks calmly down at a genius of evil, who is writhing under the weight of a shield bearing Luther's arms, which is being pressed down on him. The evil genius lies half on his back, with one foot raised and pressed against the figure of the angel. With his left arm he strives to remove the shield which crushes him down. He gazes with glaring eyes, open mouth, and contorted features at the Angel of the Reformation. The hair of his head is snake-like, and it also grows about his loins and down his legs. A very decided tail falls over in front of his body. His figure is naked, while that of the angel is clad in loose robes, which fall in picturesque folds from the arms. The composition of this group is very agreeable, especially the arrangement of the figure of the angel, with his long curling hair, his graceful wings, and well disposed costume. The shield he holds bears in a circle the coat of arms of the Reformer.

The second bass-relief shows Luther in discussion with Dr. Eck. Behind them, in a slight recess in the hall and against a curtain, is placed a figure of Christ on the cross. Above this is the date 1519. Both figures are seen in half length, as if at a window. Dr. Eck is on the left, and is clad in rich robes with a broad furred collar. His long hair is half covered by a skullcap, and his left hand raised in argument, while the right one is placed on the Papal bull, which lies on the stone sill. Luther is on the right. His face, also seen in profile, is turned full to his opponent, and is very determined in expression. He is clad in his monkish robes, has his cowl thrown back, and is still tonsured. He clasps his Bible to his breast, holding it with both hands. This group is particularly good in expression, the thin face of Eck telling well against the much fuller one of Luther. The four hands, as well as the faces, express the character of the disputants. In the third bass-relief Luther is shown in his study engaged in the translation of the Bible. Behind him is a closed window, with round panes. Above this is the date 1521, and at its side, on a bracket supported by a carved cherub, stands an hour-glass. Luther, who is clad in a gown and wears slashed sleeves, has on his head the picturesque loose soft cloth cap of the time. He bends to look at an illustrated Bible which is propped up on a desk, and is about to turn a leaf with his left hand. On the desk are manuscript sheets, and in the translator's right hand is a quill pen. The last of the four pictures in bronze shows Luther in his family circle. He holds a mandolin, on which he plays, as, in company with his two elder children—young Martin, who holds an open book, and a little girl who has her hands still on a ball—he sings his hymn. Behind is the wife, Katrina von Böhrer, in whose arms lies asleep the little Lena. There is a partly open window at the back, through which a vine twines into the apartment.

A correspondent of the *N. Y. Herald* gives the following account of the festivities on the occasion of the inauguration of the monument :

STATUE OF MARTIN LUTHER AT EISLEBEN.

EISLEBEN, Nov. 10, 1883.

Four hundred years ago to-day, between eleven and twelve o'clock at night, Martin Luther was born here. On the following day the ceremony of baptism was performed by a priest, when the child received the name of Martin, after the patron saint of that day. Sixty-three years later, on the 18th of February, 1547, the great Reformer died here. Of all the towns and villages throughout Protestant Germany, where the memory of his birth was celebrated to-day, none can vie in importance with this little place, which was the beginning and end of the Reformer's life.

It was this village, perched on the side of a hill, and looking like one of those spick and span hamlets seen on old Saxon china dishes, which was to day the focus of the German volksfest. At daybreak the chimes of Sts. Petri-Pauli Kirche, where Luther was baptized, and of St. Andreas Kirche, where Luther used to roar and thunder, pealed forth their gay carols, and soon afterward the schools of Eisleben resounded with the solemn, swelling strains of Luther's hymn, "Eine feste Burg ist unser Gott," intoned by over forty thousand human voices mingled with the drums and trumpets of half a dozen military bands.

The scene was most impressive and symbolical of the solemnity, force, and earnestness of the German people. Every house in Eisleben is literally covered with evergreen wreaths, festoons, miniature flags, Chinese lanterns, and crystal reflectors, giving the place the appearance of a forest of Christmas trees bearing, as fruit, the portraits of Luther, Kaiser Wilhelm, the Kronprinz, Bismarck, and Von Moltke. The streets are strewn with evergreen branches.

A special beer, called Luther beer, was brewed for the occasion. Mottoes and texts of Luther engraved on beer glasses and painted on walls and houses abounded everywhere in Oriental profusion. Every class joins in the celebration. The house of the richest man in Eisleben is magnificently decorated with flags, transparencies, and evergreens. Over the front door is a colored portrait of Luther, ten feet square, bearing the inscription: "Hier stehe ich; ich kann nicht anders. Gott helfe mir. Amen."

Luther's *Geburtshaus* is covered with evergreens and flags, and the small square windows are filled with lighted candles. Luther's *Sterbehaus*, opposite the St. Andreas Kirche, is decorated with a single large evergreen cross. There is no other ornament whatever.

The Marktplatz, in the center of which is Luther's statue veiled in blue and white canvas, presented a sight possible only in Germany. It was like a magnificent representation of a grand spectacular scene in Wagner's "Meistersinger von Nürnberg."

Vereins of butchers, bakers brewers, barbers, and shoemakers, all clad in mediæval dress, thronged the square. Opposite, the triumphal arches and dingy brown Gothic *Rathhaus* formed a thoroughly artistic background. Dozens of heads clustered together at every window looking on the Marktplatz. Late comers had to pay from $50 to $100 for a chair at these precious windows.

At noon the bands again struck up "Eine feste Burg," and the oldest living ex-Burgomeister of Eisleben stepped on the platform, under the Luther *Denkmal*, and made a long winded speech, scarcely audible. Then the Oberhofprediger, Dr. Koegel, pronounced an eloquent address, every word of which penetrated to the remotest corners of the Marktplatz. Dr. Koegel, who has stern, rigid features and a powerful voice, was clad in a black robe, a black velvet Luther cap, and looked the symbol of Protestant Germany.

He said a great deal about Luther being the founder of Germany's "Gewissensfreiheit," and of Luther's Bible being the "grösster Volksbuch das Deutschland kennt." Dr. Koegel then pronounced a prayer, and 50,000 spectators took their hats off and repeated the solemn "Amen." The blue and white canvas was removed from Luther's statue just as the bright rays of the sun burst out from behind the dark clouds that had since nine o'clock overcast the sky, and the national anthem was sung. In the colossal bronze statue Luther seemed to return with lifelike expression to the admiring gaze of the densely packed crowd.

Cries of "*Hoch!*" were heard on every side, and the blare of trumpets and the roll of drums resounded and re-echoed. From the other side of the Marktplatz and from beneath the triumphal arch the grand historical procession, the "Einholung Luthers in Eisleben durch die Grafen von Mansfeld, 1546," began to pour into the platz. The characters were, in their way, as well performed as the "Oberammergau Passion Play."

A squadron of Prussian cuirassiers, on black chargers, clad in scarlet and white mediæval uniforms, carried off the palm of the day by their splendid military bearing. The persons who rode in the procession seemed little surprised at their own picturesque appearance, and the man who impersonated Luther, and who rode in a dismal looking butcher's cart drawn by four horses, bore a striking resemblance to the original. The butchers made a first rate appearance as they rode on stout bay horses. They wore drab and crimson costumes, and looked as if they had stepped out of one of Wouverman's paintings.

At the head of the procession walked several elegantly caparisoned horses. After them marched a herald with the emblems of the new German Empire. He was followed by a horseman with a kettle drum. The drummer was clothed in a suit of red and white, the colors of the city of Mansfeld. He was followed by twelve trumpeters. Then came, in blue and white colors, the herald of the city of Eisleben. The Burgomaster and his staff, with a crowd of citizens welcomed the procession.

At the gates of the city they joined the procession. The color bearers of the Counts of Mansfeld came with some of the noblemen bearing their coats of arms. They were followed by a large crowd of falconers and hunters on horseback and on foot. On a large horse rode the armor bearer of the house of the Counts of Mansfeld followed by a splendid troop of noblemen of the Goldene Aue. Then were seen the Counts von Mansfeld, Albrecht and Gebhard themselves, with their wives, daughters, and the young counts who were able to master horses. In this part of the procession were seen many garbs made out of brocade, or Venetian mantles of silk or velvet suits and robes trimmed with real embroidery of Flanders.

Herewith was given a true picture of the luster and glory of the time of the Renaissance. So everything shows the immense wealth and opulence of the Counts of Mansfeld. With great favor also was welcomed the Prince Wolfgang of Anhalt, who rode on a vivacious battle horse. He was conducted by his banner bearers and marshals of his court, and he presented himself as a stately hero. As he likes very much the noble sport of hunting, he was accompanied by many hunters.

Eisleben, which now numbers some fifteen thousand inhabitants, is an ancient town, having been already in existence before A.D. 1000. Its chief points of interest are, naturally above all others, the two buildings in which Luther began and ended his life. The building in which he was born is commonly known as Luther's house. It is a small two story structure, with high gable ends, in the large Gasse, or Lutherstrasse, not far from the Post Office. Above the door is a relief representation of the Reformer.

In the popular belief the house was formerly considered incombustible until a fire broke out in August, 1689, by which the upper story was destroyed, but four years later the damage was entirely repaired by donations from all parts of Germany. Luther's birth room, however, in the first story, was actually proved incombustible, and remains unscathed to this day.

The Luther relics preserved in the house include his oval writing table and seal, showing a heart and cross in a rose. A wedding ring, also shown here, is the only copy of the well known original, with a crucifix and the inscription "Doctori Martino Luthero, 1525." The rooms of the building, which are now used as a school for poor children, are decorated with a number of interesting old paintings or epitaphs, the largest of which represents Nebuchadnezzar, by Lucas Kronach. It is some ten feet wide, and the center figure of three men in a fiery oven, protected by angels, bears Luther's features.

Another painting shows ancient Eisleben with the resurrection of Lazarus in the foreground, with portraits of Luther, his wife Catherine, and his mother. There are also other portraits of the Reformer, with those of the Saxon Electors, his protectors.

The house in which Luther died stands close to the market square and St. Andrew's Church, in which he preached so often. It was bought by the Prussian government in 1862 from its private owners and thrown open to the public after being restored to its original condition. Luther's armchair still stands in the corner of the room in which he passed his last days, but the adjoining chamber, in which he died, is a bare, empty little building, now marked with a tablet.

St. Andrew's is the old parish church of Eisleben. Erected before 1179, it was entirely rebuilt during the fourteenth century in the latest Gothic style, with octagon pillars. The church stands on the highest ground in the market square, and its front, with double towers and high spires, faces, according to ancient custom, in the direction of Jerusalem.

The most interesting object in the interior is Luther's pulpit, carved in oak and decorated with panel paintings and red velvet drapery with gold and silver embroideries representing figures of saints and scenes from the New Testament. During the last three weeks of his life, Luther preached four times from this pulpit. The church also contains a number of monuments of the Counts of Mansfeld, the last of whom died in 1620, and two small bronze statues of Luther and Melanchthon, presented by King Frederick William III. in 1817.

Eisleben's second church, that of St. Peter, contains a stone font in which Luther was baptized. The circular rim now bears the following inscription:

Rudera Baptisterium quo Tinctus est D.
Martinus Lutherus, A.D. 1483, d. 10 Nov.

A fragment of Luther's cloak and the leather cap which he wore as a singing scholar are also preserved in this church.

ORIGIN OF THE TELEGRAPH.

CHEVALIER FREDERIC FRANCHETTI, an engineer at Leghorn, has transmitted to us, says Mr. Henri de Parville, a curious passage from the Dialogues of Galileo, which it is well to make known. "*Sagrado:* You remind me of a man who wished to sell me a secret for enabling one to speak, by means of a certain sympathy of magnetized bars, to some one at a distance of two or three thousand miles. As I said to him that I would willingly purchase it, but that I would like to see the experiment, and that it would satisfy me to perform it, I being in one of my rooms and he in another, he answered me that at so short a distance the operation could not well be seen. Then I dismissed him in saying that I had no desire just then to go to Cairo or Moscow to see his experiment, but that if he, however, would go thither himself, I would do the rest by remaining in Venice."

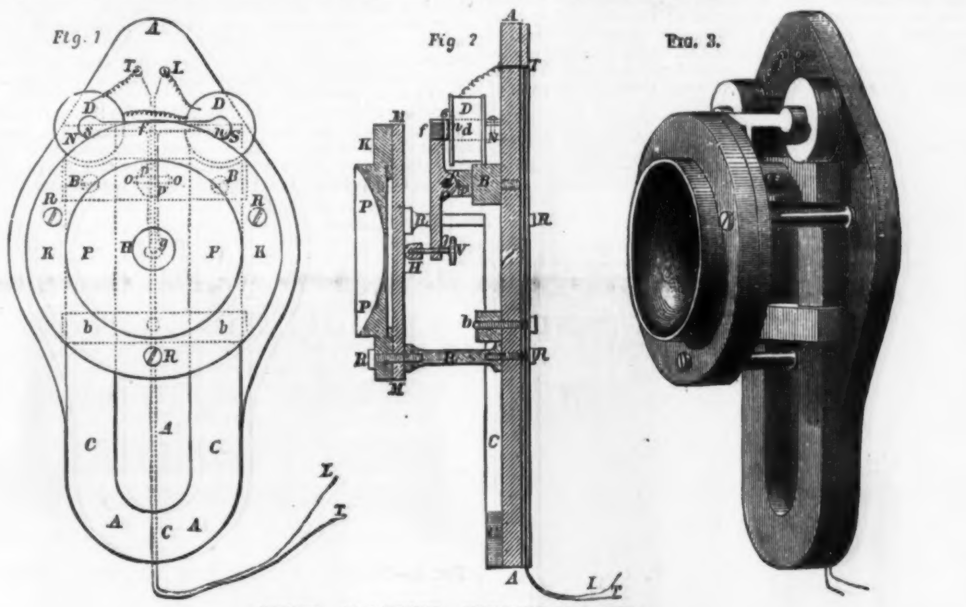
This is an extract from the Dialogues of Galileo Galilei on the systems of Ptolemy and Copernicus (Leghorn edition of 1874; Francisco Tigo), First Day, page 77. From this passage and from documents previously published, it seems certain that along about the year 1625 the report had spread throughout the different countries of Europe that it was possible to correspond at a distance by means of magnets. This doubtless has to do with merely a simple conception that had been brought forward by some imaginative savant. Such are to be found in all ages.—*La Nature.*

THE LABYE TELEPHONE.

WE have heretofore referred to an ingenious and very efficient telephone transmitter, shown under the name of the pantelephone, by the inventor, M. De Locht Labye, Ingenieur des Mines, of Liege. The remarkable feature of this transmitter was its extreme sensitiveness; it would receive and transmit clearly the vibrations caused by the articulations of a speaker standing with his back to the instrument, and thirty yards from it; and it was thoroughly efficient, at a distance of four yards, in transmitting whispered sentences. The instrument consisted of a single rectangular plate of cork, hung freely from two thin brass or steel strips. To the bottom of the sheet of cork was fixed a button of hard carbon, held in light contact by a slight inclination of the plate, with a piece of platinum. This constituted the whole of the transmitter, which has now been supplemented by the equally ingenious and efficient receiver which we illustrate on another page.

Considerable interest attaches to this latter instrument. Its articulation is at least as clear as that of the Bell telephone, while its action differs considerably, and the diaphragm common to other telephones is replaced by a thick and mechanically rigid abutment plate. According to M. De Locht Labye, the action of this telephone cannot be explained by Bell's theory of undulatory currents. Mr. Bell claims as a point of vital importance, that in order that speech may be transmitted and reproduced, a flexible plate should be employed, and this must be put into undulatory movement corresponding to that of the air waves, in order that such undulations may reproduce the air waves; and that to effect this, it is necessary that the connecting line between transmitter and receiver should be constantly traversed by a continuous current, the undulations in which produce the vibrations of the diaphragm.

On the other hand, M. Laybe maintains that in his telephone articulate sounds are reproduced by a series of rapidly succeeding but absolutely intermittent blows struck on the abutment plate, the amplitude and rapidity of these blows depending of course on the impulse transmitted through the line, and being rendered audible by an exact reproduction of continuous sounds, the ear not being sufficiently sensitive to mark the intermissions, supposing them to exist. Without dwelling on this theory, we may describe the telephone, which is illustrated by a front view in section, Figs. 1 and 2, and by a perspective view, Fig. 3. To a wood-



THE LABYE TELEPHONE.

en plate, A, is secured by brass brackets, B, *b*, a powerful horse-shoe magnet, NCS. To each pole is attached a small core of soft iron, *d*, surrounded by the coils, DD, of silk insulated copper wire; these coils are included in the telephonic circuit, the conductors of which are shown at L and T. Opposite the cores of the small electro-magnets, DD, which are covered with gold beater's skin, or some other thin material, are the ends of a bar armature, *s n*, kept from actual contact with the cores by the film just mentioned. This armature, which is of soft iron and relatively heavy, is rigidly attached in the center of its length to a bar of brass, *f g*, which swings on its axis, *o*, fixed to the post, *p*, which is made in one with the strap, B. The lower end of this lever, which is thus free to oscillate, is traversed by a screw carrying at one extremity the small hammer, H. This hammer rests against the center of a thick disk of ebonite or other material, M, which is screwed rigidly to a resonator, P, the whole being secured to the base plate, A, by means of the metal posts, RR. By means of the screw, V, at the end of the hammer, the space between the poles of the magnet and the armature, necessary to give the clearest articulation, can be very accurately adjusted.

Like the Bell telephone the instrument we have described can be used either as a transmitter or a receiver. The form, thickness, and practically the material of the abutment plate, M, are indifferent, although the circular shape illustrated is probably the most convenient. Ebonite, hard wood, cork, metal, or stone give clearly articulate vibrations, and paper or leather folded to as great a thickness as the range of the armature lever will allow may be interposed between the abutment plate and the hammer, without checking the clearness of the transmitted speech. The two parts—the abutment and the resonator—may be made in one piece, and the more rigidly this organ is fixed, the more efficient the telephonic duty appears to be. If, on the other hand, a thin flexible sheet is substituted for the abutment plate—such as the ordinary Bell diaphragm, disks of mica, aluminum, etc., the sounds are very considerably reduced, and if the armature lever be connected to the abutment plate, all audible transmission ceases.

The inventor thus describes the action of the instrument when used as a receiver: "The telephonic currents circulating in the bobbins cause the armature to be alternately attracted and repelled. By reason of the reaction of the rigid obstacle against which the armature lever rests, the repulsion

alone is effective in producing the first movements of the armature. The latter in moving away from the pole momentarily separates the hammer at the end of the lever from the buttress or rigid obstacle. This repulsion is succeeded by the attraction of the armature caused by the following current, and the armature is then pulled back to its original position, and tends to pass beyond this position by reason of the attraction and its own *vis viva* or momentum, but is stopped in this direction by the rigid piece or obstacle against which the hammer strikes. The intensity of the blow or shock consequently results from the combined effect of these two actions, and is in direct ratio to the electro-magnetic forces which produce the repulsion and attraction of the armature. The number of shocks is equal to the number of electrical charges produced in the telephonic circuit.—*Engineering.*

PILES AND ACCUMULATORS AT THE MUNICH EXHIBITION OF ELECTRICITY.

PILES designed for general application were slimly represented at the Munich Exhibition, and the majority of those that were exhibited formed part of electro medical apparatus.

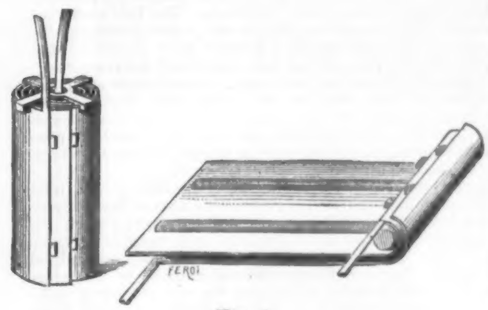


FIG. 1.

We may cite, however, the well known bichromate pile that accompanied the Griscom motor, the plunging piles of Fein, of Stuttgart, and a lime pile, of the Gandini system, exhibited by the Societa Industriale Franco-Italiana of Milan. This last named apparatus, whose elements are inclosed in varnished sheet-tin vessels, is not practical. Various houses likewise exhibited Leclanche elements or parts of

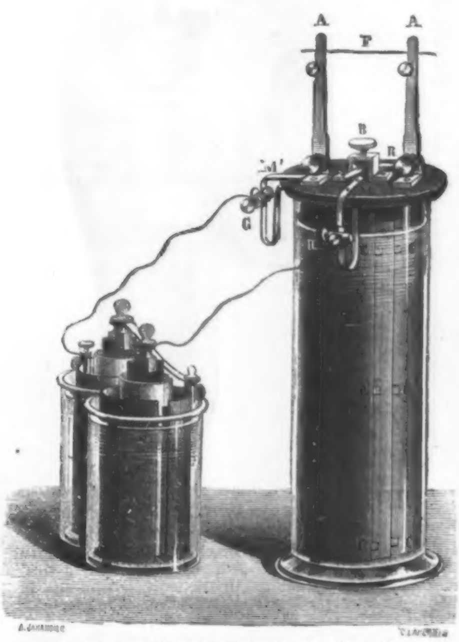


FIG. 2.—PLANTE'S SECONDARY PILE.

such. Mr. J. Bendl exhibited different kinds of carbons, the house of Gerzabeck & Co. presented carbons in plates and prisms for Bunsen, Leclanché, and Stoehrer piles. Dr. Lessing exhibited Hipp's manganese briquette and carbon and manganese cylinder elements, and Mr. Minner had on exhibition crystallized and crushed manganese for Leclanché elements.

FIG. 3.—PLANTE'S ELECTRIC LIGHTER.

But if this section of piles, properly so called, presented nothing peculiar, it was not so with the secondary ones, or accumulators. The principal known types of such apparatus were represented, and, in addition thereto, some others were shown that had not before made their appearance.

Among the former it is proper to mention, in the first place, Mr. Planté's secondary piles. This gentleman exhibited a group of apparatus and pictures which formed, so to speak, a resume of his labors. First, there was his insulated element formed of two leaden plates rolled together, with bands of rubber to separate them (Figs. 1 and 2), and immersed in a vessel of acidulated water. Two Bunsen elements (Fig. 2) are sufficient for charging this element and covering one of its plates with peroxide of lead, while the other remains in a free metallic state. It was these insulated elements that Mr. Planté first made use of and put to a certain number of applications. For example, the model shown in Fig. 2 was arranged by him for exhibiting, during courses of lectures, the incandescence of a platinum wire under the

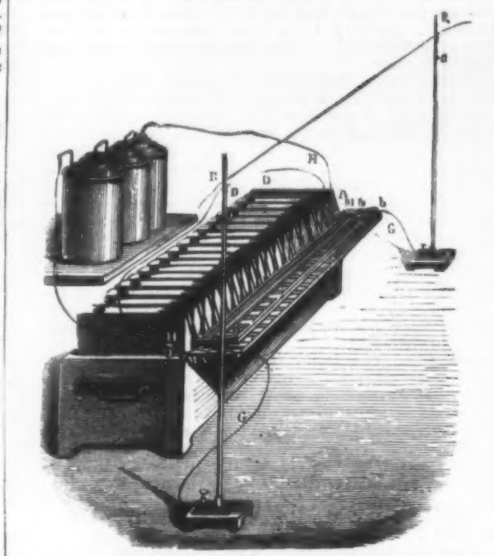


FIG 4.—PLANTE'S COUPLE IN BATTERY FORM.

influence of a powerful current. The two small Bunsen elements, which of themselves would have been incapable of producing such incandescence in the wire employed, were capable of effecting it through the intermedium of the secondary pile. The same type of element is the one which, slightly modified a little later on, has become the base of Mr. Trouve's polyscope.

Another application of his insulated pile that was made by Mr. Planté was the "Briquet de Saturne"—a small lighter shown in Fig. 3. Here a small mahogany box supports in front a small aluminum candle, and above this there is held between two binding screws a platinum wire.

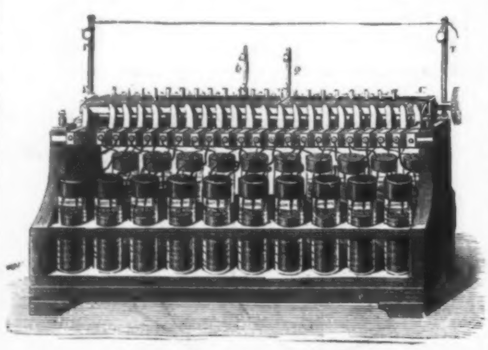


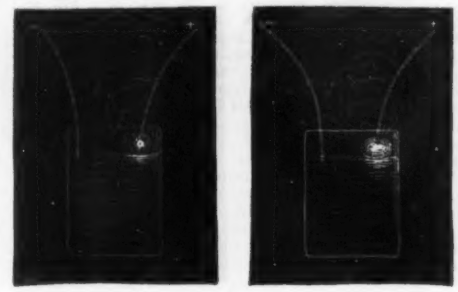
FIG. 5.—PLANTE'S COUPLE IN BATTERY FORM.

The box contains a secondary pile which is kept charged through the contact of its two terminals, C, with a Daniell pile of three elements. When the spring, T, is pressed, a current is caused to pass into the platinum wire, and the incandescence that is produced lights the candle.

Although the Planté couple of itself afforded material for but few applications, it presented especial interest in the form of a battery. In this shape, all the elements could, in the first place, be associated in quantity and charged with a pile of feeble tension—with two Bunsen elements, for example; and, then, their grouping being changed, they could be reunited in series for the discharge, in such a way as to have at one's disposal for a few instants a source of very great tension.

The first arrangement employed by Mr. Plante for this purpose is shown in Fig. 4. The couples, forty in number, were aranged in rectangular troughs.

Each of the leaden plates terminated, through its prolongation, at a strip of copper whose extremities carried springs,



FIGS. 7 AND 8.

which were capable of being pressed either by metallic bars, MM', NN', or by an insulating bar, BB', whose under side was of metal. These bars were connected together in such a way as to form a frame which could be tilted. In the position shown in the figure, all the springs of the plates belonging to every other row are pressed by the rod, MM', and all the springs of the other rows by the rod, NN'. The couples are thus united in quantity. When the insulating bar is depressed, its metallic parts unite the springs in tension, and consequently the corresponding couples also.

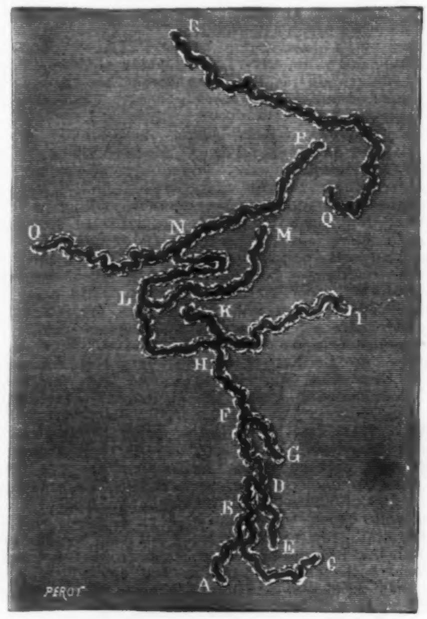


FIG. 9.

This arrangement was soon replaced by the one shown in Fig. 5. Here the couples are arranged in two rows, and above them there is a wooden bar that carries two rows of vertical springs. All the poles of the same name are connected with one of these rows, and all those of contrary name with the other. An insulating bar, CC', that carries a metallic one on each side, connects all these springs in quantity for the charge. If it be turned 90°, it presents to the springs a series of pins that connect them in pairs and

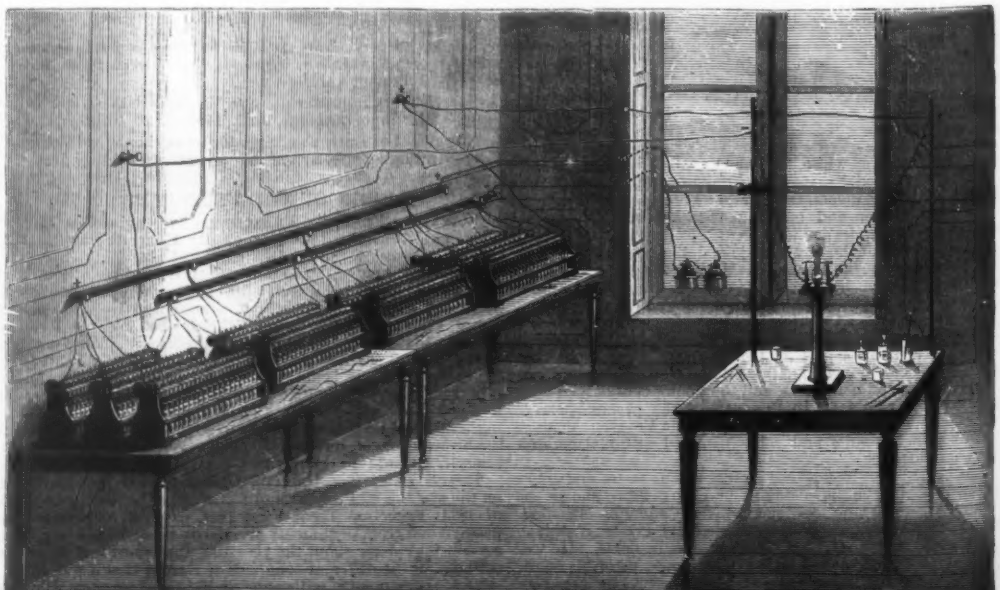


FIG. 6.—PLANTE'S BATTERIES UNITED FOR EXPERIMENTAL PURPOSES.

unite the elements in tension. It requires a few hours to charge an apparatus that has been already formed.

With these batteries, Mr. Plante in starting with a charge of two Bunsen elements, was enabled to produce effects that usually require a powerful current source. He succeeded, for example, in producing an arc electric light for

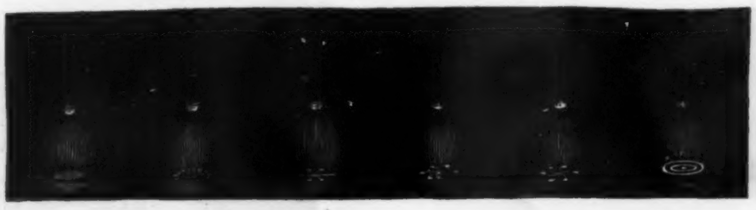


FIG. 10

a few instants, and in raising a very long platinum wire to incandescence, etc. But it was especially by uniting together, as shown in Fig. 6, several of these batteries so as to raise the number of elements to 200, 400, 600, and 800, that he was enabled to obtain remarkable effects and study those peculiar phenomena that are due to currents of high tension. His battery had even the advantage that while it produced a high tension it did not have a great resistance.

With his apparatus he found it possible, with an acidulated water and platinum wire galvanometer, to observe that

FIG. 11

luminous sheath that surrounds the magnetic electrode when the current is sufficiently powerful (40 secondary elements).

With 200 couples he was enabled to produce what appeared like globular lightning. If, into a salt or acidulated water voltameter, we first plunge the positive electrode, and then bring the negative one near to the surface, we will obtain sparks at its extremity; but, if we plunge the negative electrode first, the positive one will give rise to

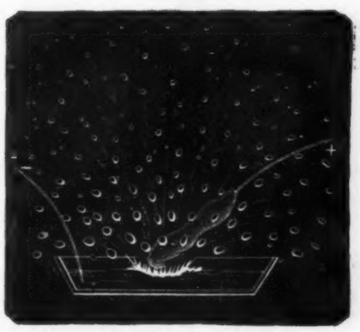


FIG. 12.

a luminous globule of vaporized matter (Fig. 7) which soon takes on a gyratory motion and assumes a flattened form (Fig. 8). This phenomenon is accompanied with a sound that appears to proceed from successive condensations of the material.

With distilled water and 800 couples, when the positive electrode is plunged in in advance, the negative one gives rise to a yellow flame which, by a little separation, becomes converted into an ovoid globule. The sparks that are then produced on the surface of the water give rise to the different effects that are shown in Fig. 10.

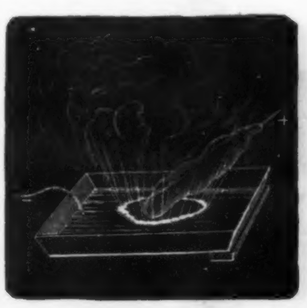


FIG. 13.

An experiment that gives effects that still further simulate ball lightning as we observe it in nature may also be performed with the 800 couples, in using a mica condenser for charging. If the sheet of mica presents a small point, it becomes pierced at that spot like a too highly charged Leyden jar, and the spark will be observed to persist in the form of a globule, which, melting the tin, plows up the surface of the plate as shown in Fig. 9.

When 400 couples, instead of 200, are employed along with a salt or acidulated water galvanometer, the phenomenon changes, and instead of a globule we obtain a spray of globules as shown in Fig. 11. This phenomenon is again produced when the extremity of the positive pole is surrounded with bibulous paper soaked in salt water (Fig. 12). But, when the quantity of salt water in the voltameter is small, it becomes heated, and the globules are replaced by a disengagement of steam (Fig. 13). We may also cite the electric "Mascaret" (Fig. 14), a sort of wave obtained by resting the positive electrode against the edge of a vessel of water, while the liquid is in communication with the negative pole.

With a current from about 300 couples, if the positive electrode is a Wollaston one, and we introduce it into the liquid as shown in Fig. 15, the glass and platinum will be observed to melt in the center of the mass and give out a bright light.

This vitreous light can also be produced by resting the positive wire against a plate of glass a little above the surface of the liquid (Fig. 16); and, finally, an analogous phenomenon may be obtained with quartz (Fig. 17).

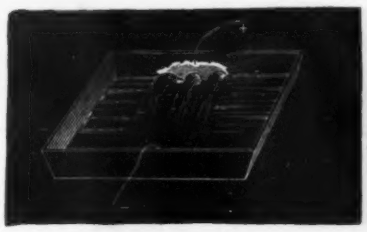


FIG. 14.

Upon putting the negative electrode into the liquid, and placing the positive against the moist sides of the vessel, we obtain, according to the electrode's position, one of the several phenomena shown in Figs. 18, 19, and 20, that is to say, a luminous crown, an arc edged with brilliant rays, or a sinuous line having a rapid undulatory motion.

Another experiment that Mr. Plante has classed among

FIG. 15.

the effects of high tension, although it may be performed with ten or twenty couples, is the following:

When the liquid in the voltameter is acidulated water, and the positive electrode is of copper, for such tension of current, the seat of oxidation is at the extremity of the wire, and the latter makes a hissing noise and gives rise to a prolonged jet of oxygen. If the vessel be placed over an electro-

FIG. 16.

magnet, the cloud of oxygen will be seen to take on a gyratory motion (Fig. 21), and the oxide that is carried along on the other pole will move in an opposite direction.

Such are the principal phenomena which have been obtained by Mr. Plante by means of his powerful apparatus, and which have served as a basis for the very ingenious views that he has put forth upon analogous atmospheric ones, and which have led him to a few applications.

Thus, for instance, he has devised a process of electric engraving upon glass, utilizing for this purpose those corrosions that occur in the phenomenon of vitreous light. The plate to be engraved (Fig. 22) is placed in a pan, and the positive wire is run along its edge. The negative wire, inclosed in a glass tude, is moved by hand through a thin stratum of a concentrated solution of nitrate of potash. A lumi-

FIG. 17.

nous furrow follows the course of the wire, and the glass is at the same time engraved. But one of the finest applications that Mr. Plante has made of his apparatus is their use for charging his rheostatic machine. The secondary battery

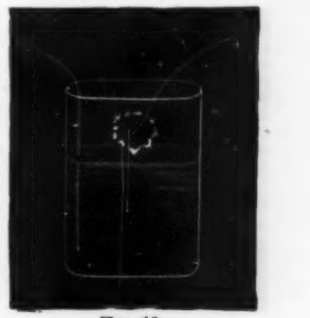


FIG. 18.

transforms the work of the voltaic pile in such a way as to give temporary effects of quantity or tension that are much superior to those from any given pile. The object of the rheostatic machine is to transform the work of the pile in

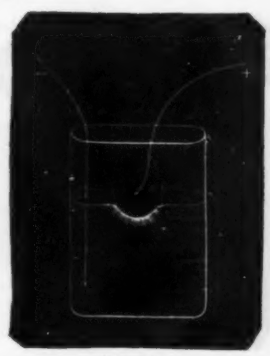


FIG. 19.

such a way as to have a tension comparable with that of static machines. This apparatus (Fig. 23) resembles a secondary battery in its arrangement, save that the elements are here replaced by mica and tin condensers, and that a winch permits of revolving the commutator that unites them now in tension and now in quantity. The two extreme poles have the form of an exciter.

The apparatus is connected with 600 or 800 secondary elements that charge the condensers in quantity. Then, the

FIG. 20.

commutator being revolved, the pile becomes excluded and the condensers are discharged in tension. The effects are then analogous to those of a very powerful static machine.

It will be seen from this to what extent Mr. Plante has carried a scientific study of his apparatus. This latter has even begun to enter into practice in connection with Achard's electric brakes and various electro-medical apparatus.

Mr. Faure has endeavored to render it better adapted for the industries by replacing the natural formation by an arti-

ficial one. Mr. De Kabath and others have done the same. The piles of these two inventors were represented at Munich by a single specimen only.

In addition to apparatus already known, we have to call attention to those of Messrs. Schulze & Boettcher. Fig. 25

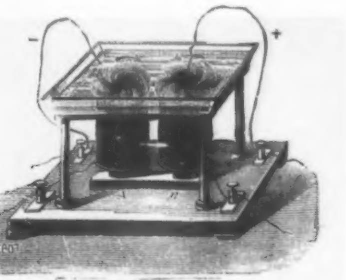


FIG. 21.

represents one element of the Schulze pile, and Fig. 24 shows a battery composed of such elements

Mr. Schulze covers the parallel leaden plates that form his accumulator with a paste of flowers of sulphur, and, by heating these, he forms upon them a layer of sulphuret of lead. If these plates be put into water acidulated with one-tenth part of sulphuric acid, and the current be made to pass, the sulphur separates, and the plates assume the requisite spongy condition.

At the Munich Exhibition a Schulze secondary battery of thirty elements operated eight Edison lamps, or one arc lamp, and served for the transmission of power.

The machine employed for charging these accumulators was the Schuckert, situated near the falls of Hirchau, at 5 kilometers from Munich, and this served at the same time to run two lathes.

Mr. Boettcher's accumulater is not, like that of Schulze and its predecessors, composed solely of leaden plates, but contains, as a negative electrode, a zinc plate instead of a lead one, and the element itself is filled with sulphate of zinc. His apparatus has the form of a plunge pile, as shown in Figs. 26 and 27. The zinc plates, Z, which are U-shaped, surround the lead, *p*, which is of undulatory form, and are separated from it by parchment paper, F. The whole thing has a general resemblance to the Wollaston pile.

When the accumulator is charged, there is formed peroxide of lead, which, at the discharge, is converted into protoxide. But, as soon as such conversion is at an end, the protoxide of lead, the zinc, and the zinc sulphate form a new couple which prolongs the duration of the current.

This accumulator should have a greater storage capacity than those using lead only; but exact calculations have not as yet been made in regard to this.

If experience should confirm the inventor's provisions and

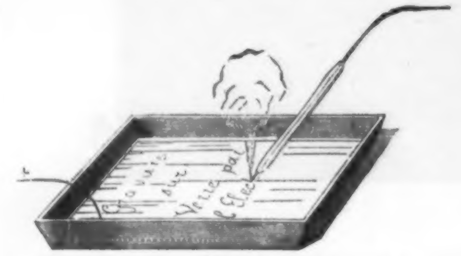


FIG. 22.

a greater effective duty be obtained, the apparatus at all events would have to be given a more practical form and not be allowed to preserve the laboratory arrangement that it now has. The transformation, however, would be easy to effect.

The two accumulators that we have just mentioned present a certain interest in that they are not, like the majority of those that have been brought out in recent times, simple modifications in form of the Plante or Faure pile.

The first is distinguished by an original mode of formation, and that is the preliminary conversion of the surface of the lead into a sulphuret. It must be said, however, that this process, although it allows the metal to be obtained in a suitable spongy state, has at least the draw back of disengaging sulphureted hydrogen—a gas that is injurious as much through its bad odor as through the action that it exerts upon metals in blackening them.

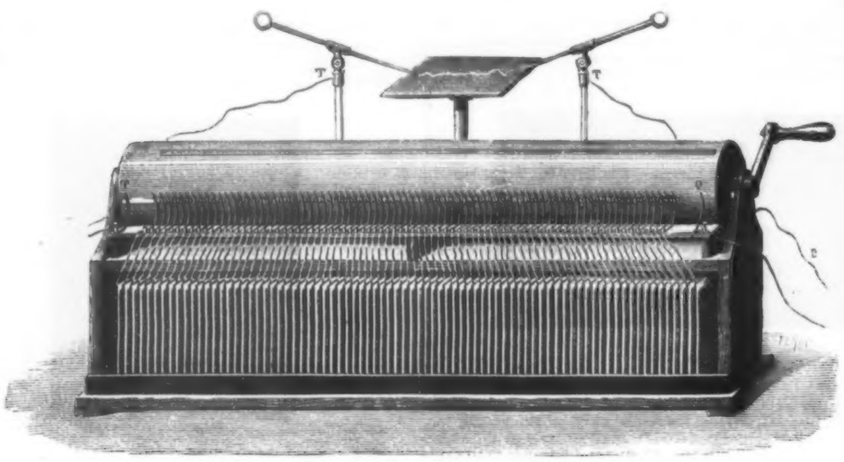


FIG. 23.—PLANTE'S RHEOSTATIC MACHINE.

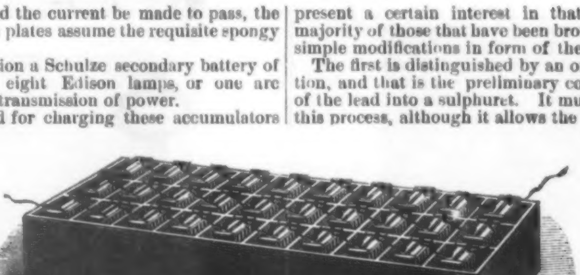


FIG. 24.—SCHULZE'S BATTERY.

FIG. 25.—A SINGLE ELEMENT OF THE SCHULZE BATTERY.

FIG. 26.—ARRANGEMENT OF THE PLATES IN THE BŒTTCHER ACCUMULATOR.

The second presents as a peculiarity the use of zinc, and it is possible that we may have here a reason for the increase in the storage power of the couple.

There was likewise shown at the Munich Exhibition a peculiar accumulator which was based upon the use of bromine, and which was due to Prof. Zenger of Prague. As the inventor has not as yet taken out all his patents, he was

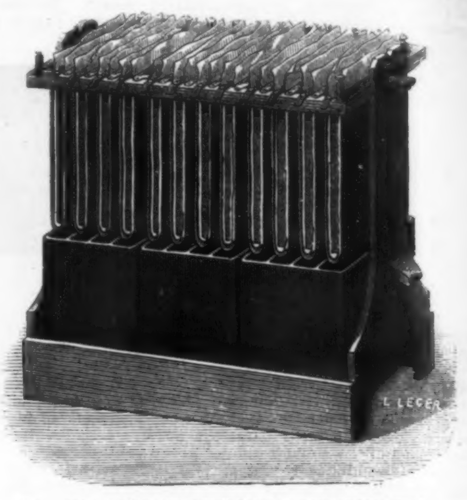
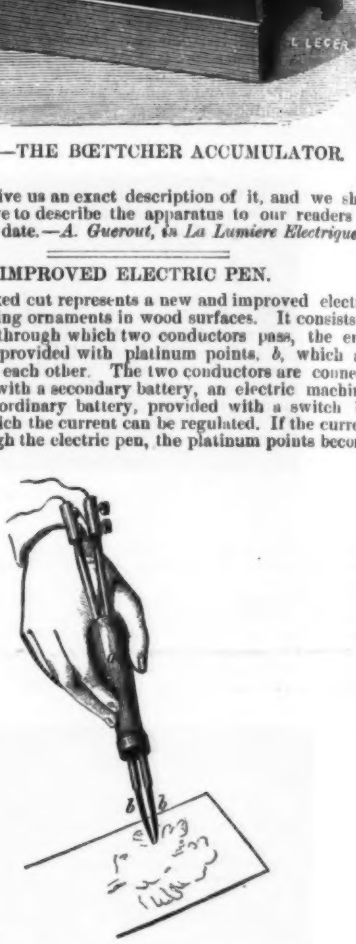


FIG. 27.—THE BŒTTCHER ACCUMULATOR.

not able to give us an exact description of it, and we shall therefore have to describe the apparatus to our readers at some future date.—*A. Guerout, in La Lumiere Electrique.*

IMPROVED ELECTRIC PEN.

THE annexed cut represents a new and improved electric pen for burning ornaments in wood surfaces. It consists of a handle, *a*, through which two conductors pass, the ends of which are provided with platinum points, *b*, which are held close to each other. The two conductors are connected by wires with a secondary battery, an electric machine, or with an ordinary battery, provided with a switch by means of which the current can be regulated. If the current passes through the electric pen, the platinum points become



incandescent, and when drawn over or held in contact with the wooden surface to be ornamented, burn lines, etc., into the same. With some skill very elegant designs and novel and beautiful effects can be produced on wood surfaces by means of this pen. The pen is known as the electric or pyrograph pen.—*Illustrirte Zeitung.*

IMPROVED INCANDESCENT ELECTRIC LAMP FOR MINERS.

MR. GASTON PLANTÉ has exhibited an incandescent electric lamp for miners, at the Vienna electrical exhibition, an

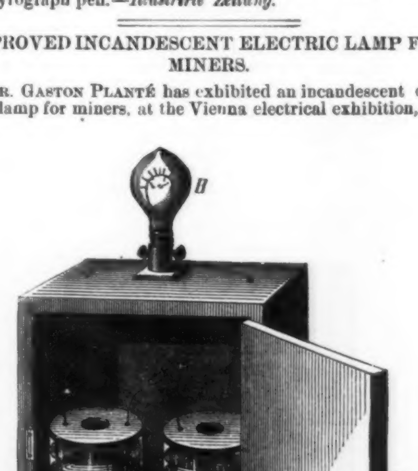


illustration of which lamp is given herewith. It consists of a small box containing two Plante secondary batteries, A A, and a small Swan incandescent lamp, B, of three volts. The box is provided with a suitable handle for carrying it and with suitable contact buttons for making the connections

to charge the batteries. By means of two Bunsen elements the secondary batteries can be charged in about one hour, which charge is sufficient to cause the lamp to burn for about an hour. Ordinary lamps cannot be used in mines after an explosion has taken place, as the air does not contain sufficient oxygen for the flame, but the above described incandescent lamp requires no oxygen and burns for a sufficient length of time to enable a miner provided with an air purifying device to explore a mine immediately after an explosion with perfect safety. The lamp weighs about four pounds.—*Illustrirte Zeitung.*

FOOD ANALYSES.—FLOUR.

To the Editor of the Scientific American:

Having occasion to make an analysis of certain flours as to the relative amount of starch and gluten they each contained, I thought that the process adopted, being simple and one easily carried out by persons of ordinary intelligence, it would interest your readers and give them the means of ascertaining for themselves the food value of any flour they might at any time be using as food in their families. Before entering into an explanation of the process adopted it will be as well to briefly describe the different processes used in the manufacture of flour. In its earliest history flour was made by the pulverization of the wheat grains in a mortar. The next improvement in the method of manufacturing flour was the substitution of mill stones in place of the mortar, and grinding grain between them. The resulting meal was afterward bolted, thus separating the fine flour from the bran and coarse granules called *kernel* or *middlings*. The kernel or middlings, together with the bran, were sold as food for animals, and it was known that

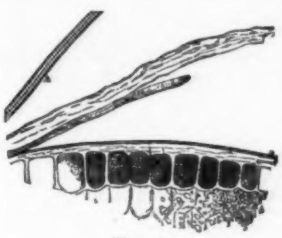


FIG. 1.

these kernels possessed the richest food properties of the wheat, but it was impossible to reduce them to fine flour under the existing system, because if the mill stones were run too closely together, heat would be generated to such an extent that the softer starch properties were killed and the flour badly injured. The direction given to inventive skill, was to devise the best plan, method, or system of dressing the mill stones, and hundreds of mill stone dressers were invented, besides tools and implements to do the work of dressing. The object of thus dressing the stones was to produce the greatest yield of fine flour and least middlings or kernels.

In striving to remedy the evils of the old process of milling, an important and radical change resulted and soon became known as *new* or *patent process*. By the new system the old process was reversed, and instead of grinding close to produce flour, the new process adopted the system of grinding *high* (this process being called high milling in Hungary, where it was first adopted), in order to make as many middlings or granules as possible. The *chop* or meal from the stones was carried to a bolt, which bolted out the flour and then separated the middlings from the bran. These middlings were then carried to a machine, called a purifier, which is a graded shaking bolting cloth, so operated that as the middlings enter and pass over the cloth, a strong suction of air is drawn up through them, carrying off the light bran particles and impurities that speck white flour. The middlings thus purified drop through the meshes of the bolting cloth and are conveyed to mill stones or rolls, reduced to fine flour, and rebolted. The flour thus obtained from these middlings is called patent or new process, and is the result of the invention of the purifier. The *new process* system, having revolutionized the *art*, inventive genius was again challenged to produce the best means of producing the greatest amount of millings in the process of reducing the grain, as the percentage of patent or new process floor separated on the greatest yield of middlings. Many inventions were produced, but at

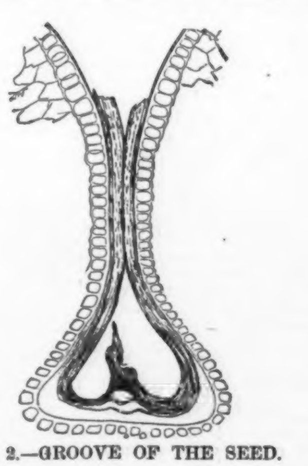


FIG. 2.—GROOVE OF THE SEED.

present corrugated iron or steel rolls are considered the best. These rolls are set in pairs, each pair being corrugated differently from *coarse* to *fine*, and the reduction is gradual; the *chop* being bolted each time it passes a pair of rolls, the middlings and flour, taken out, and the scalped chop passed to the next finer pair of rolls and so continued until only the bran remains. Roller process differs only from new process, or patent, in that the middlings are made on rolls instead of on mill stones, and the yield of middlings is greater, and freer of impurities.

The great study in all the improvements in milling has been to produce a pure white flour, regardless of its food value. In order that this might be accomplished, different grades have to be made, depending upon their color or speckiness for their standing. New process mills make about 60 per cent. of new process flour and 40 per cent. of inferior grades out of every 100 barrels produced.

It will be seen, readily, that white flour is an uneven product, and does not possess the food elements of the wheat in natural proportions nor in their entirety. Within a short time another process of manufacturing grain into fine flour, has been invented and adopted by the Franklin Mill Co., of Lockport, N. Y.

The process is essentially as follows:

The grain is first unbranned by means of special machinery, as shown in Fig. 1 (from Hand). By this process, the entire food properties of the wheat are preserved in the flour in natural proportions, and the largest amount of gluten ever found in fine flour (17 per cent.) is obtained. Now this process is not a complete one, as may readily be seen by an examination of Fig. 2 (from Hand).

This shows that the bran, situated in the groove of the grain, has not been removed. This bran, if allowed to remain in the flour, gives a certain amount of color to it. We will now enter into a description of the process of analysis of flour, as to the amount of gluten and starch they may contain. The white flours examined by the writer were those having the greatest reputation with the general public. Among these *Pillsbury's "Best"* was found to contain the largest amount of gluten (2·65 grains in 2,000, or 13¼ per cent.).

Two other flours reached the very high figure of 12 per cent. Prof. Horsford's report on Vienna bread (1873) gives the average per cent. of gluten in good flour as 10 per cent. Now this exhibit is very creditable to American industry and skill. The other flours examined were the two standard *dark flours*, viz., Franklin Mills' flour of the entire wheat, Lockport, N. Y., and the Health Food Co.'s cold blast gluten flour, 10th St. and 4th Ave., N. Y.

A certain portion (2,000 gr.) of each of these flours was mixed with water, separately from the rest, and inclosed in a piece of muslin, as we inclose a pudding. This inclosed dough was then kneaded in a certain amount of water in order to separate the starch from the rest of the flour. During this kneading process, water readily passed through the cloth to the dough, and back again to the remainder of the water, carrying with it on its return the starch cells, albumen, and sugar. By continuing this kneading process, the starch, sugar, albumen, and gum were finally separated from the gluten, which remained a soft, tenacious, elastic substance, insoluble in water, inside the cloth. The gluten was then removed from the inside of the cloth, moulded, dried, and weighed. The water containing the starch, gum, albumen, and sugar, was placed in a vessel and allowed to stand for some hours, in order that time might be allowed for the starch-cells to settle to the bottom.

At the end of this time, the water was poured off and the starch moulded into a cake, dried, and weighed. In the examination of the Franklin Mills' and Health Food Co.'s flour, an additional process was required. During the kneading process, described above, the fine bran with adherent gluten cells, was forced through the cloth, and became mixed with the starch-cells in the water. This water had to be filtered through very fine lawn muslin. The starch-cells readily passed through this cloth, but the bran was detained on the muslin, and afterward collected, dried, and weighed. As the purpose of this analysis was not to ascertain the amount of albumen, gum, and sugar contained in the flours, but rather the amount of gluten and starch, the examination was continued no further. But if the reader should desire to ascertain how much albumen, gum, and sugar a certain amount of flour contains, the following process may be adopted. Take the water poured off from the settled starch, and boil it. This will coagulate the contained albumen, which can be collected on a filter, dried, and weighed. The water that passes through the filter can afterward be evaporated over boiling water, and the gum and sugar collected, dried, and weighed.

Figs. 3 and 4 show the relative amount of gluten and starch contained in 2,000 grs. of Pillsbury's best flour. Figs. 5, 6, and 7 show the relative amount of bran, gluten, and starch contained in 2,000 grs. of Franklin Mills' flour. Figs. 8, 9, and 10 show the relative amount of bran, gluten, and starch contained in 2,000 grs. of Health Food Company's flour. Upon weighing the illustrated samples of bran, gluten, and starch, the following results were obtained:

	Bran.	Gluten.	Starch.
Pillsbury's Best..........	......	265 gr.	1,600 gr.
Franklin Mills' Flour of Entire Wheat..........	50 gr.	315 gr.	1,000 gr.
Health Food Company's Cold Blast Gluten Flour..	150 gr.	140 gr.	900 gr.

One curious feature connected with the analysis of the Health Food Company's flour is the large percentage of bran residue. Now, the highest percentage of bran found in the whole grain is but 5 per cent., yet the Health Food Company's flour contains 150 grains, or 7½ per cent.

In order to ascertain if the microscope gave any explanation of the above results, the writer placed a portion of each of these flours on different slides, moistened them with water, covered each with a small glass cover, and examined them in turn, using a ¼ Gundlach objective and a No. 2 eye piece. In examining flour under the microscope, there is great difficulty experienced in ascertaining the relative amounts of starch, gluten, and bran found. An approximate estimate can only be made. For, if we take the unruptured gluten-cells as a gauge of the amount of gluten in a given specimen of flour (Pillsbury's), we are sure to be led astray, as there are no gluten-cells to be seen, while it (Pillsbury's) contains 13¼ per cent. of gluten. Again, if we try to ascertain by comparison the amount of granular gluten contained in the specimen, we are apt to be deceived, as there is so close a resemblance between the granular gluten and the small granules of starch. Therefore, the microscope, alone, is not a complete test of the value of flour as to the relative proportion of its food elements. But it is invaluable accessory to other modes of examination.

The following illustrations and descriptions of the same will assist the reader in understanding these statements.

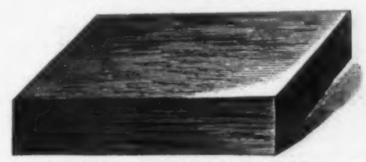


FIG. 3.—GLUTEN FROM PILLSBURY FLOUR, 265 GRAINS.

FIG. 4.—STARCH FROM PILLSBURY FLOUR, 1,600 GRAINS.

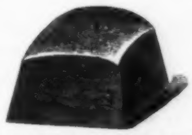


FIG. 5.—BRAN FROM FRANKLIN MILLS' FLOUR, 50 GRAINS.

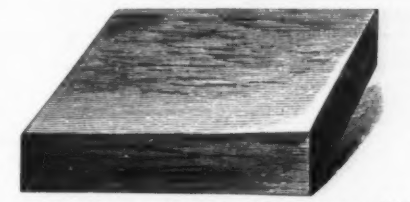


FIG. 6.—GLUTEN FROM FRANKLIN MILLS' FLOUR, 315 GRAINS.

FIG. 7.—STARCH FROM FRANKLIN MILLS' FLOUR, 1,000 GRAINS.

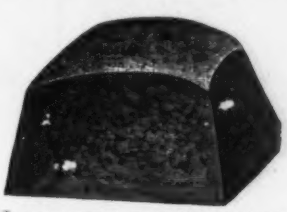


FIG. 8.—BRAN FROM HEALTH FOOD FLOUR, 150 GRAINS.

FIG. 9.—GLUTEN FROM HEALTH FOOD FLOUR, 140 GRAINS.

FIG. 10.—STARCH FROM HEALTH FOOD FLOUR, 900 GRAINS.

Fig. 11. represents the appearance of Pillsbury's flour under the microscope. Here are seen the giant starch cells, A; B, smaller starch cells; and C, granular gluten. Fig. 12

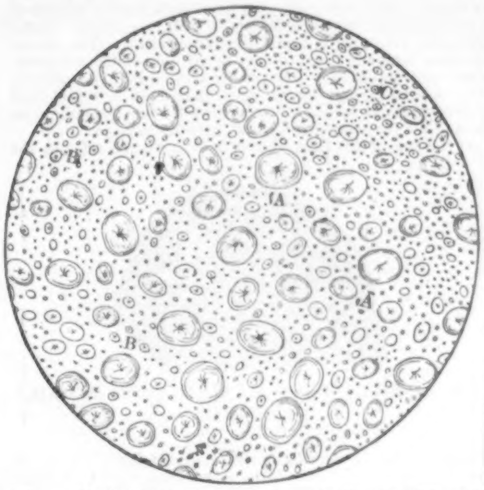


FIG. 11.—PILLSBURY'S BEST WHITE FLOUR AS SEEN UNDER THE MICROSCOPE.

represents the appearance of the Franklin Mills' flour and equally well represents the Health Food Company's flour, with the exception that in this flour is seen a *much larger proportion* of the bran coat with gluten cells attached, as well as unattached, together with some *hairs of wheat*, than is found in the Franklin Mills' flour. In Fig. 12, A, are seen giant starch-cells, B, portion of bran coat; C, portion of

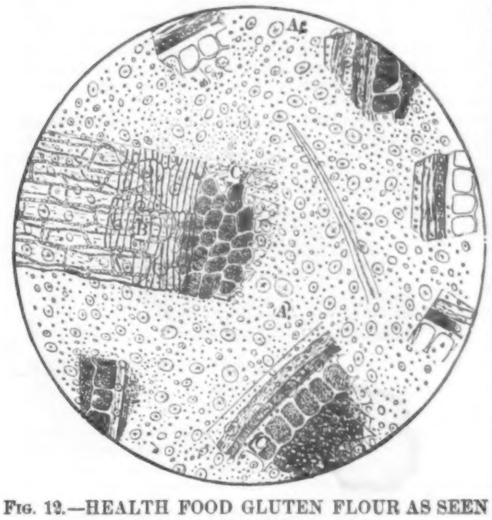


FIG. 12.—HEALTH FOOD GLUTEN FLOUR AS SEEN UNDER THE MICROSCOPE.

bran coat with gluten-cells unruptured. To sum up the result of our examination of these flours: First, we find that Pillsbury's gives us a very fine white flour, containing a large per cent. of gluten (265 grs.), or 13¼ per cent. with no bran residue. Second, the Franklin Mills Company furnish a very fine flour containing the largest amount of granular gluten ever found in a fine flour (315 grs.) and retaining a small per cent. of the bran coat (50 grs.). Third, the Health Food Company give us a flour containing a very *small* amount of granular gluten (140 grs.) and a *very large* percentage of bran (150 grs.), larger than is natural; indicating that bran is added to the natural flour and presented to the public as "Health Food." Now, if we allow one-half the bran residue in the analysis of Franklin Mills' and Health Food Company's flours to consist of *gluten-cells undetached from the bran coat*, then we shall swell the amount of gluten contained in these flours to the following figures: Franklin Mills, 340 grs. or 17 per. cent.; Health Food Company's, 215 grs., or 10¾ per cent.

A. T. CUZNER, M.D.

November 1883.

[Much of the foregoing information will be found embodied in Dr. Cuzner's excellent work entitled, "What we Eat, and What we Drink."—EDS. S. A.]

ADULTERATION OF MILK.

M. GEORGES KRECHEL has recently called the attention of the Academy of Sciences in Paris to a new species of the old complaint which has so long exercised the Health Boards of cities, *i. e.*, adulteration of milk. Two milk companies of Paris, which furnish the larger portion of the milk consumed in the French capital, have attracted his attention through the constant preference given to the product of one which is regarded as the sweeter and thicker, and whose superior qualities were attributed to the fresh and nutritive pastures enjoyed by the cows yielding it. An examination proved, that though the lactometer indicated no striking or even perceptible difference between this apparently richer milk and ordinary milk, it contained glucose sirup which had been reduced by water.

The analyses of the two milks gave the following results; the unadulterated, density 1·034, gave:

Butter	8·45
Caseine	22·30
Lactose	37·22
Ash	7·10
Albumen	4·92
Water	920·01
	1,000·00

This indicated a skimmed milk, but otherwise normal; the adulterated, density 1·068, gave:

Butter	24·30
Caseine	21·70
Dextrine	10·56
Lactose	26·25
Glucose	10·20
Albumen	3·50
Ash	7·35
Water	896·14
	1,000·00

This latter analysis indicates a composition of ¼ water and glucose sirup, and ¾ normal milk.

The composition of cow's milk, after MM. Millon and Coumaille, varies between the following limits; parts in a liter = 1·05 U. S. quarts:

	Maximum.	Minimum.	Mean.
Butter	53·00	38·00	40·00
Caseine	36·83	33·90	35·00
Lactose	48·56	41·64	44·25
Albumen	....	....	5·25
Ash	8·42	6·10	7·03
			131·53

This change in the character of the milk cannot be regarded with indifference, however harmless it appears to be. The glucoses sold commercially frequently contain arsenic in amounts by no means inappreciable. This proceeds from the arsenic contained in the sulphuric acid used in the conversion of starches to this substance.

This is particularly true of acids formed from pyrite, and hence M. Krechel solicits the attention of the Board of Health of Paris to what might prove a serious danger.

KEEPING THE TEETH CLEAN.

By C. E. FRANCIS, D.D.S., M.D.S., N. Y.

IT is a deplorable fact that the mass of mankind are culpably negligent in caring for their teeth.

Useful as are these organs as aids in the promotion of health, comfort, and longevity, they are often sadly abused, and, as a consequence, not infrequently do they prove rebellious and become a source of dire annoyance.

Many people defer visiting a dentist until driven by relentless pain to seek relief, after having vainly exhausted the various domestic remedies suggested by sympathizing friends By that time, in all probability the offending member and perhaps several others are found to be in an exceedingly dilapidated condition; possibly ruined. In such cases very likely all the remaining teeth have become badly stained or coated with incrustations of salivary calculus; with gums purple and tumid, and ready to bleed at the slightest touch.

Some mouths, so far as the invasion of a tooth brush is concerned, are unexplored caverns of a miniature type; and others, which receive but an occasional visit from this intrusive explorer, are not in a much better condition for the little care bestowed upon them.

But there are many, very many, well meaning individuals who habitually brush their teeth, and some even declare that they perform this duty twice, thrice or four times daily, yet cannot keep their teeth from becoming stained or covered with "tartar."

Who has not witnessed cases where the teeth, after having received a most thorough cleansing by a dentist, have within a few months after been again covered with accumulations as repulsive to the eye as if they had never been cleansed? And yet, when expressions of surprise follow such discoveries, assurance is given that the tooth brush is regularly used!

It is certainly disheartening to a dentist who, after having taxed his best efforts to save from total destruction a set of teeth nearly wrecked by abuse and neglect, to subsequently find them again stamped with stains, and their interstices loaded with extraneous matter.

On the principle that "like causes produce like results," teeth ever so skillfully treated by the dentist, if in this manner are constantly menaced by invasions from such mischievous elements of decalcification, what wonder is it if fillings occasionally become undermined with decay and prove failures?

"Why cannot I keep my teeth free from 'tartar'?" is a question frequently asked by discouraged patients. "It is not from lack of brushing," they say. To express a doubt as to *thoroughness* on their part is a delicate thing to do, yet proofs are sometimes painfully apparent to warrant such a doubt. Undoubtedly many individuals imagine they are particular in this respect when they are not.

The fact is, very few persons know how to properly manipulate a brush; nor do they know what sort of brush to select. Scarcely one in ten of the brushes manufactured is fit for use, and this statement is no exaggeration. Many are too large and unwieldy to be successfully managed, and would be more suitable for "nail brushing." The majority of them are also too compact; some too rigid and not sufficiently pliable to be useful, while others are too soft and little better than rags. The brush for service should never be broader than the medium sizes usually sold, nor over two-thirds their length. The bristles should be elastic and their ends trimmed in serrations, or "notched"—this form being best adapted to the shape of the teeth.

In use the brush should be pressed firmly against the teeth, commencing with the back ones at their cervical borders, and with a semi-rotary motion slowly brought forward and toward their grinding edges in such a manner as to force from between them accumulations that have found lodgment there; also allowing the bristles to come in contact with all enamel surfaces possible to reach.

Rapid horizontal dashes should be avoided. A brush furiously driven across the teeth touches only points of enamel that least require rubbing, leaving the accumulations that load their interstices undisturbed or unmolested.

It is not the frequency of brushing that best preserves the teeth, but the degree of thoroughness with which it is done. The time for performing this duty most effectively is just before retiring for the night. During the twelve hours' interval from the evening meal to the morning repast, particles of food retained about the teeth and subjected to the warm humid condition of the oral cavity, cannot fail to become decomposed or fermented, thus breeding an insidious foe that, night after night, besieges the enamel walls, which, unless of extraordinary compactness, will sooner or later give way to its destructive forces.

There is no objection to cleansing the teeth when making the morning toilet, yet if thoroughly cared for the night before, they require comparatively little of such attention in the early part of the day. To brush them more frequently than this is a needless task.

"Prevention" being considered better than "cure," it would seem an important part of the dentist's duty to give such instruction to his patients as will enable them to keep their teeth in a condition of cleanliness.—*Independent Practitioner.*

CHOLERA GERMS.

WRITING from Alexandria on the 17th of September, after declaring that there can be no doubt that the epidemic in Egypt was really one of cholera, Dr. Koch says:

"On examining the bodies of the victims no traces of living organisms have been found in the blood, the liver, the lungs, the spleen, the kidneys, and other organs which are usually affected by germ diseases. Now and then it happened that bacteria were discovered in the lungs, which, however, stood in no connection with the course of the disease, having reached the lungs through inhalation of the evacuations. In the contents of the intestines, as well as in the ejections of cholera patients, great masses of various kinds of organisms were discovered, none of which, however, could be said to exceed the others in numbers, nor were there any other signs from which it might be concluded that they had any relation to the course of the disease. One important result was obtained from the examination of the intestines. In all cases, with the exception of one in which death had occurred several weeks after the cure from cholera, a certain kind of bacteria was discovered in the walls of the intestines. These rod-like bacilli resemble those found in horses diseased with glanders. In cases where the slightest change was visible in the intestines, the bacilli had penetrated into the glands of the thin mucous membrane, greatly irritating it, as was seen in the enlargement of the opening of the gland, and the accumulation of circular cells in the interior of the gland. A great number of the bacilli had made their way behind the epithelium of the gland, and had settled between it and the glandular membrane. Besides this a large number of bacilli had settled on the surface of the villi, and in many cases had penetrated their tissues. In bad cases, where the glandular mucous membrane was invaded by a bloody infiltration, the bacilli were found in large numbers, and were not confined to the invasion of the utricular glands, but had penetrated into the surrounding tissues in the deeper stratum of the mucous membrane, and sometimes even into the muscular skin of the intestines. The villi of the intestines were also in such cases covered with bacilli. The principal seat of these changes is in the lower part of the small intestines. If this discovery had not been made on fresh corpses, it would have been entirely useless, the influence of decay being sufficient to produce similar bacterian growth in the intestines. . . . The number of bodies dissected by Dr. Koch is small, but as the bacilli have been found in all fresh corpses of cholera patients, and were not to be found where death was caused by other diseases, there remains no doubt that they stand in some relation to the development of cholera. Nevertheless, the fact that the bacilli have been found in the intestines in cases of cholera does not prove that they are the cause of the disease. Whether the assumption is correct that the process of infection or the invasion of bacteria is primary, can only be decided by the attempt to extract the bacteria from the diseased tissues, to rear them in an uninfected place, and to attempt the reproduction of the disease by the infection of animals. For this purpose it is necessary to have the disposal of such animals as are susceptible to infection by the germs. Hitherto such animals have not been found, and all experiments on rabbits, guinea-pigs, dogs, cats, monkeys, pigs, and others have invariably failed. That the germ of disease is frequently contained in the excreta of cholera patients has been proved by experience, particularly by the frequent infection of those who have washed the soiled clothes of cholera patients.

"It may therefore be assumed with certainty that at least some of the experiments which have been tried have led to the identification of the real germ of the disease. If as yet no conclusive results have been obtained, the cause may have been that those animals on which the experiment was tried were altogether unsusceptible to cholera, or that the correct way of infecting them has not yet been found. The experiment is being continued, though with the present scanty material there is little hope that anything further will be discovered. It is, however, improbable that the above reasons are the only causes of the failures in attempts at infection. There is still another explanation. It is well known that in a place attacked by cholera the disease disappears long before every individual has been infected, and that although the germ of the disease is, after some time, diffused over the whole place, the number of patients diminishes more and more, and the epidemic disappears while there are yet a number of persons susceptible to infection. This can only be explained by the assumption that toward the end of the epidemic the cholera germs become inactive, or at least act no longer in all cases. If, then, men are no longer susceptible to infection toward the end of the epidemic, it is not to be expected that animals should be more susceptible than men, especially as it is not known as yet whether they are at all liable to cholera. Far removed as we are yet from the entire solution of the problem, and little as the results obtained will practically aid in subduing the cholera, they may be regarded as favorable, if we consider the unfavorable circumstances and the short time in which they had to be gathered. They answer perfectly to the original idea, and even go beyond; for by the constant discovery of characteristic micro-organisms the first condition which has to be fulfilled in cases of infectious disease has been satisfied."

TREATMENT OF PREMATURE BALDNESS.

DR. LASSAR contends (*Berliner klin. Wochenschrift*) that premature baldness is the result of contagion, and not of any general condition of the health. The method of treatment recommended is as follows: The scalp is to be washed every day with tar soap or soft glycerine soap, or with soap containing sodium iodide; the soap is to be thoroughly applied, and rubbed into the scalp for fifteen minutes. Following this, a warm douche is used; then after the application of a corrosive sublimate solution (two parts in one thousand) the hair is dried, and a half per cent. spirit solution of naphthalin is rubbed into the affected parts. Carbolic or salicylic acid may also be employed. If this treatment be adopted in the early stage, when the hair is just beginning to fall, it usually proves successful, but it must be kept up for eight weeks or more. The fact that this disease is due to a communicable morbid principle suggests that it may be conveyed by the comb and brush of the barber.

[AMERICAN NATURALIST.]

THE GROWTH OF PLANTS IN ACID SOLUTIONS.

BEFORE the plants could be analytically examined they became disarranged and some identifications lost. The following items are interesting:

The hydrochloric acid plant was examined for chlorine, the whole plant being divided into three parts. The top, embracing leaves and portion of stem, contained 0·205 grain of chlorine; the middle or stem to within a few millimeters of the first roots, 0·1373 grain of chlorine; the roots, 0·102 grain of chlorine. The sum of these amounts gave 3·54 per cent. of chlorine in the entire plant. The hydrochloric acid formed soluble chlorides which were taken up by the plant. The percentage of chlorine in plants, excluding strand or beech plants, seldom exceeds one per cent.

The parts of another plant similarly divided into top, middle, and roots gave, upon maceration in warm water, an alkaline reaction which, when titrated with acid, yielded the following results: the titration of the top converted into decinormal alkali equaled 0·294 grain carbonate soda; the middle gave 0·0432 grain, and the roots 0·049 grain carbonate of soda, or considering the alkali as soda, 1·3 per cent. of soda for the whole plant, a fairly average percentage for plants of this description.

The percentage of ash of the other plants was determined in order to observe if the use of acid waters had increased the mineral matter of the plant through its solvent action upon inorganic ingredients of the soil. This examination gave the following results:

	Wt. dried plant.	Percentage ash.
Water plant............	1·1615 grammes.	19·11
Carbolic acid plant	0·5135 "	16·60
Nitric " "	0·536 "	16·79
Formic " "	0·5535 "	18·15
Salicylic " "	0·5885 "	17·00
Tannic " "	0·6975 "	19·80
Tartaric " "	0·9325 "	14·74

Considering the devitalized condition of the acid plants mentioned above, and the decreased weights of the others in this table below that of the water plant, it is evident that the acid waters tend to introduce inorganic ingredients into the tissue of the plants.

During the last winter I have kept hyacinth bulbs in acid waters identical with those used upon the geranium plants, adding to them oxalic acid. The effect upon the plants was deleterious and destructive. The water plant flowered upon March 7th, having numerous roots, a tall flower stalk, and leaves six inches long. The hydrochloric acid bulb died, as did the sulphuric acid subject, though one month later. No roots appeared upon any acid bulb except a few in the tannic acid solution. The plants were low, the flowers appeared without scapes, and the leaves attained under these averse circumstances, at the best, a height of three inches.

On March 31st the tannic acid bulb flowered and the flowers were a dark purple, much deeper in color than those of the water plant. The bulbs were supposed to be one variety, having all one color. On April 1st the tartaric acid plant flowered, the flowers just emerging from the bulb. The citric acid plant flowered at the same time. The oxalic acid plant flourished better than the rest, except that in tannic acid. On April 29th the nitric acid bulb pushed open a few pale flowers and died. This summer geranium plants will be watered with acid solutions and grown upon silicious, calcareous, and feldspathic soils.—*L. P. Gratacap, 77th Street and 8th Avenue, New York City.*

PYRUS PINNATIFIDA.*

IT will be seen from the synonymy cited below that considerable doubts exist as to the exact nature of this tree as a wild species. By some it has been considered as a hybrid between the White Beam, P. aria, and the Mountain Ash, P. aucuparia, but there is no certain evidence as to this, nor can we be quite sure that this is the form reported to grow wild in Arran, and nowhere else in Britain. In any case, in gardens it is pretty generally known under the name here adopted, and is a tree of moderate height, with oblong leaves pinnately cut, especially toward the base, and with the lower surface covered with hoary down. The white flowers are borne in loose corymbose clusters, and are succeeded by scarlet fruits, as represented in our figure. As an ornamental tree it is amply worth growing for the sake of its foliage and the rich color of the fruit. The tree is perfectly hardy, and deserves to be more widely known.—*The Gardeners' Chronicle.*

* *P. pinnatifida*, Ehr., Smith, *Engl. Bot.*, t. 2,331; De Candolle's *Prodromus*, ii., p. 263. Sorbus hybrida, Linn., ex-Loudon, *Arboretum*, ii., p. 915. Pyrus fennica, Bab. Sorbus fennica, Kalm, ex Syme. Sorbus hybrida, Fries, ex Syme. Cratægus Aria, var. *β*, Linn., ex Syme. Pyrus Aria, sub-sp. fennica, Hook. f., *Student's Flora*, p. 126.

PYRUS PINNATIFIDA: BERRIES SCARLET.

THE CACAO NUT.

THE cacao tree is very common in the warm regions of America, but since the conquest it has been only cultivated in Mexico, where the natives belong to the Toltec or Aztec stocks, in Guatemala, and Nicaragua. Under Montezuma, the Spaniards transplanted this tree in the Canary Islands, upon the shore of Venezuela, and in the Antilles. It demands a rich, deep, and wet soil. Nothing suits it so well as cultivated or broken forest or wood land, localities shaded, at a slight distance from the sea, or on the banks of streams. Whenever a country is chosen for its cultivation, shade is first secured, trees are left standing, or seeds of rapid growth planted, as those of the banana palm, *Erythrina umbrosa*. South of the equator, in the province of Guayaquil, the planting begins with the seeds themselves, while in Venezuela they are started in nurseries, where every precaution is taken to protect the young plant from the heat of the sun. The seed sprouts in eight or ten days; in its second year the cacao tree attains a height of about a meter (3·28 ft.); it is then lopped or trimmed. The tree flowers in thirty months under favorable conditions, that is, a heat averaging 27° to 28° C., 80·6° to 82·4° F.

The flower is very small and most disproportionate to the volume of the fruit; after opening, it measures about 0·004 meter. The corolla consists of ten petals surrounding five silver white stamens. The flowers do not appear single but in bouquets at all elevations, upon the branches and upon the woody roots creeping over the earth. From the fall of the flowers to the maturity of the fruit, almost four months elapse. The fruit, or *cabosse*, is divided into five lobes; its weight varies from 300 to 500 grammes (0·66 to 1·1 lb.). The seeds taken from it are exposed to the sun during the day and at night are heaped up in a pile. Soon an active fermentation is under way, which would be hurtful if it increased. From 100 kilogrammes (220 lb.) of fresh seed, 45 to 50 kilogrammes (110 lb.) of dry merchantable cacao are sometimes obtained. A cacao tree having attained the age of seven or eight years furnishes of cacao annually about 0·75 kilogramme (1·65 lb.). At Gigante, in the high Magdalena, the yield is about 2 kilogrammes (4·4 lb.).

The cacao is skinned by the application of a gentle heat; the shell, becoming broken, is carried away by winnowing. In drying by heat, the seed acquires, as that of the coffee, an odor due to a small amount of a volatile principle. This is the aroma that is perceived in chocolate. The cacao bean is rich in nutritious principles, besides a large quantity of fatty material; nitrogenous substances similar to albumen and caseine are found in it. Theobromine and ternary compounds are extracted. These elements vary necessarily in amount, as is seen in the various analyses published. A specimen from Trinidad, upon analysis, gave butter, starch, theobromine, asparagine, albumen, gum, tartaric acid free and combined, soluble cellulose ash, and indeterminable ingredients. The cacao skinned, slightly roasted, and freed from germs, is the base of chocolate. In the French articles, 55 to 59 per cent. of sugar is found; in the Spanish, 40 to 53 per cent. In chocolates properly prepared there is only sugar and cacao, of the former of which too much injures their quality. The Mexicans made with cacao a paste that they called *chocolatl*, in which there entered a little maize.

Chocolate contains in a small volume a large proportion of nutritious elements. Humboldt remarks that as in Africa rice, gum, and butter enable the traveler to traverse the deserts, so in the new world chocolate and farina render accessible the plateaus of the Andes and its vast forests. By the association of albumen, fat, sugary matters, and phosphates, the cacao suggests the composition of milk, the type, according to Prout, of all nutritive aliments.

Finally, in cacao we find leguminous, albuminous, fatty, saccharine, amylaceous substances, phosphates, theobromine, and a delicate aroma; in all, a storehouse of useful food, whose representative in chocolate should always have a place in our domestic life.—*Boussingault, in Cosmos les Mondes.*

GRASSES FOR LAWNS.

A CORRESPONDENT of the *Country Gentleman* says: In turning a lawn or dooryard, the quality of the soil must be considered if the best results would be obtained. There are two general distinctions of soil—clay loam and alluvial deposit—each of which has a distinct effect upon the character of the turf. In this section we have a striking example of the two. Our upland soil is a drift deposit, composed to some extent of stones, gravel, and sand, but principally of clay, the surface soil through cultivation having become a loam. The point that distinguishes it from the lower soil along the river and the streams, as affecting the lawn, is its quality of retaining seed, in a dormant state, of most or all our native plants. They remain dormant till favorable weather starts them, usually a moist, warm season. Irrigation and manure have the same effect. Hence, after the soil is well prepared and enriched for a lawn, without seeding or sodding, a native crop of grasses and weeds will occupy it. They will appear all the same if the ground has been seeded, though tardily at first; and if a grass not adapted to the soil has been sown, it must eventually succumb. Only the strong native growers and naturalized plants, adapted to the soil, like June grass (*Poa pratensis*), can be expected to maintain themselves—not exclusively occupy the soil, for other grasses and weeds will encroach upon them, new ones continuing to appear as our changeable climate calls them forth, till the turf becomes a heterogeneous mass, changing the even aspect of the lawn, varying its color, and marring its velvety appearance by coarse blades and tufts, and an unequal growth.

Of the many intruding plants, white clover is the most aggressive, spreading gradually but surely till it covers the entire ground. No grass, however close, seems to be able to bar its course. Then there are the "panic" grasses, some of them the most annoying of weeds. It is impossible, therefore, to establish and keep established a uniform turf of fine grass on such soil, as I have had occasion for many years to know. My most difficult task was to rid my dooryard of "finger grass," which for years had occupied part of the ground and kept advancing and thickening, threatening to overrun the entire surface of the yard. I knew of no way to remove it except pulling it up, which was not difficult, as it sits on the surface. It was a sorry sight to see the yard after the task was accomplished. I then sowed the bare spots with blue-grass, gave them a light coat of road dust, followed by a drenching of diluted urine and free watering. Moist weather succeeding, in a few weeks the bare spots were all greened over with a nice growth of fine grass. I have conquered the pest, but only for a time; it will appear again, as will other weeds, to be removed, as it is the nature of the soil to produce them.

Land adjoining my lawn has lain common for half a century. This has all the native grasses. Though turned down by the plow, as some has been, the seed still remains, and in due time, if the land is given rest, it vegetates and occupies the soil again. It was in this way in this section that formerly farmers were furnished with their grass. No seed was sown then, the soil producing a native growth spontaneously. The grass was mostly red-top, which flourished on the clay loams. There were also the blue grasses, the smaller flat-stalked species growing abundantly on the rocky and drier ground; and if now such ground is plowed it will after a while, if laid down, produce it again; and no grass forms such a velvety turf, so dense and so even. On its own peculiar soil it is the prevailing grass, often the sole growth and permanent, responding readily to manure, as when sheep have been kept upon it, which vastly thickens it and deepens its color to a rich blue-green. It is a tough little grass. The drought may bleach it, but cannot kill it. It will be found more or less in all lawns and dooryards on our upland drift, appearing more in some, where probably the soil is better adapted to its growth. Whether it can ever be made the sole grass in our lawns is doubtful, on account of the tendency of the other grasses to intrude, most of all the white clover, which makes a fair turf, but not to be compared with the other.

I am interested in the spread of this grass growing in spots in my lawn and dooryard. So far only the white clover has been able to penetrate it. As it widens its circle—it is a creeper—no other grasses are seen to occupy it, which is a hopeful sign, as it may perchance be made to grow successfully in soil where it will not be disturbed by the clover. If such should be the case, the true lawn grass will have been found, without a rival in any respect. I feel inclined to think that this little grass may yet be the means of ridding our upland lawns and dooryards of the mixture of the many grasses and gross weeds that now possess them, without which I see no possible way to get a satisfactory turf, as it is the nature of the soil to favor, and probably continue to favor, this multitude of undesirable plants.

On our alluvial land, flooded in the spring, we have soil better adapted for lawns. There is much less trouble here from weeds, and little from the encroachment of the grasses. The grass sown, if a vigorous grower, is able to maintain itself, soon becoming dense and forming a safeguard against intruding plants. In that part of the village on the low ground near the river some of the finest dooryards are seen. These have mostly been sown to June grass (*Poa pratensis*), and some are of many years' duration, covered with a thick even growth of fine bladed grass. The soil is deep and rich, a black mould with perfect natural drainage, maintaining its turf without manure except what enrichment it gets from the clippings. The few trespassing plants which appear are easily removed.—*F. G., Fort Plain, N. Y.*

ARTIFICIAL CHICKEN RAISING.

It is now quite a number of years since patent incubators and artificial mothers have been offered in our market for the hatching and brooding of chickens, independently of the services of the real, live, broody hen. Those parties who have invented the machines have, as would be expected, made the best showing possible, under the circumstances, and many of them have been able to produce large numbers of chickens by artificial methods. There is a wide difference in the several machines offered by inventors, and a volume of over a hundred pages has been published, setting forth the advantages of each under the inventor's own hand, which volume also contains a few criticisms on the machines of rivals, all of which makes very useful reading for one who contemplates going into the business of raising chickens artificially. The machines have been used long enough already to settle the question beyond dispute, as to whether healthy chickens can be brought out by these artificial methods; and if every necessary attention be given to the eggs while in the incubator, there should be a larger per cent. of eggs hatched than usually are under hens, for hens will sometimes carelessly break their eggs by stepping upon them, and occasionally will desert their nests entirely, or leave the eggs so long uncovered that the embryos will perish.

Chickens hatched under the hen are also subject to many perils and mishaps. The old birds often have lice, which are wise enough to soon learn that chickens' meat is preferable to old fowl. They take their young into all manner of dangerous places by day, and expose them to animals of prey by night. They lead them through wet grass, and do not always brood them when they are cold. By the use of the incubator and artificial brooder in careful hands, all these adverse conditions, which so tend to decimate broods, are avoided or overcome, and the attendant in charge can calculate upon hatching nearly all the fertile eggs, and rearing a large percentage of the chickens hatched. The requisites are fertile eggs, a uniform temperature, varied, however, somewhat between the first and the last periods of the process, a sufficiently moist atmosphere inside the machine, and regular turning of the eggs as often as is necessary.

After the chickens are hatched, they must have clean, comfortable, warm, and healthful quarters, wholesome food at frequent and regular intervals, pure water to drink when they are old enough to require it, and when young must have some kind of an artificial brooder or step-mother to crawl under at night, and whenever they choose during the day. Not too many must be allowed to run together, or the weaker ones will be trampled and crushed. Their bodies must be kept entirely free from vermin, for even an artificial mother may become infested with the small poultry lice which live in hen roosts, and as the birds increase in size their ranges must be extended according to their needs.

Now, all this means constant care and watchfulness, and if the number of birds be large, a great deal of real, though not necessarily very hard work. There are so many continually going into the poultry business only to become disgusted with it after about one year's experience, that we should never advise one who was utterly inexperienced in the business to invest in an incubator at first, for there would be too much to learn all at once, and the chances would be ten to one that the machine would be for sale at the end of a year, if not sooner; but if one is already familiar with chicken raising by ordinary methods, has been successful at it, and desires to extend the business, and to push it in some directions, independent of the moods of mother hens, we should recommend looking into the artificial methods.

It must be remembered, however, that incubators are useless without fertile eggs to put into them, and that the "time" of a sitting hen at certain seasons of the year is proverbially cheap, as when they *will* sit whether they have eggs under them or not. It must be remembered, too, that chickens reared at extra cost must come to market at a season when poultry sells high, or the extra expense will leave little or no profit for the poultry keeper.

Incubators allow of hatching eggs, if one can get them, at seasons when sitting, or broody, hens are difficult to obtain, and in this, we believe, lies their chief merit; for in late spring, when the hens are all broody, they may as well be sitting on eggs as in empty nests. If, after the hens have hatched their broods, it is believed that their motherly attentions can be dispensed with, the artificial mother can be employed just as well as for artificially hatched eggs. In warm weather, this method often gives satisfaction where the attendant is constantly on hand whenever services are required; but unless one has the best of accommodations, it will be much less work to permit one good mother hen to take charge of a pretty large number of chicks. The hen will lead her young out among the insects, and will teach them which to eat and which to reject, will protect in a measure from hawks and cats, and at the proper time will lead them to the roosts.

The most successfully managed establishment for hatching and rearing chickens artificially, that we have ever visited, is that of W. V. Thompson & Co., of Woodville, Mass., who raise several hundred chickens annually. They have an "Eclipse" incubator that stands in the family living-room, and makes as ornamental a feature in the furnishing as a sewing machine or cabinet organ. After the chickens are hatched, they are removed to a large building erected specially as a chicken nursery, which is heated by steam or hot water pipes passing through the entire length of the building, and just enough above the ground floor to allow of the downy babies crawling under them to warm their little backs. The pipes are four or five inches in diameter, wound with cloth to keep the heat from passing away too rapidly, and to make a soft covering for the birds as nearly like that of the real mother as is practicable. The floor of the room is of sand, and is kept quite warm under the pipes, so that the chickens find a comfortable and healthful place where they can at all times warm their feet as well as other parts of their bodies. More chickens probably die in early spring from cold feet and legs than from all other causes combined. The chicken house is kept constantly clean, and the air is pure and wholesome, and suitable runs are provided outside, which the chickens can occupy at will, at all seasons of the year. Of the several hundred birds of all ages, from a week old to three months, which we saw running in this house at one time, there were none that did not look bright and healthy.

In a letter recently received from the Thompsons, they write: "Artificial chicken raising is a trade to learn, and takes time and money to make it a success; but when the trade is once learned, we think no one will go back to the old way."

A large majority of those who start out in poultry raising, as in many other kinds of business, begin without first learning the "trade," as the Thompsons express it. Hatching chickens, even by the use of an incubator, is but a small part of the trade. At Woodville, a house for laying hens is filled in the fall with birds of right age to lay eggs suitable for hatching, and they are kept so healthy, and in quarters so nearly like what they have naturally in summer, that only a comparatively small proportion of their eggs are infertile, as those would be from flocks that are habitually cold and uncomfortable. In no case will it pay to purchase an incubator, unless a considerably large amount of work is to be done with it.—*N. E. Farmer.*

MR. BONNER ON FAST TROTTERS.

Unlike his office in *The Ledger* building, the walls of which are covered with the portraits of famous trotters and famous authors, Robert Bonner's sitting-room at his private house gives no evidence of the tastes of the owner for horse-flesh and literature. Mr. Bonner, who is a thick-set, youngish-looking man, with keen eyes and a reddish beard, sat in his easy chair the other evening caressing one foot with his hand, and chatting on his favorite hobby to a *Tribune* reporter.

"I think I may lay a modest claim," said he, "to be an authority on the trotting-horse, and it was, curiously enough, a mere chance that led me to take an interest, which subsequently became an engrossing one, in that subject. It is more years ago than I care to recall that I came to this city from Hartford, on *The Courant* of which city I had been working in a literary capacity. Soon after my arrival I started a venture which soon took my whole care and attention. For some years I worked day and night, till my health began to give way. One day my old family physician walked into the office, and after telling me how ill I looked, said: 'Robert, I want a check for $300.' 'What for?' I asked. 'To buy you a horse,' answered he. Well, he did so, and for a while I tried saddle-horse exercise, but soon found that it did not agree with me. Then I took to driving, and I have driven ever since, and behind some pretty fast horses, too, let me tell you. I have seen great changes, though, since the day I first drove out by my doctor's orders to gain health and strength. In those days the owners of fast trotters were as a rule either 'sports' (which was then another name for gamblers) or butcher-boys and the like. For several years old Commodore Vanderbilt, Colonel Harper, the senior member of the publishing firm, and myself were perhaps the only respectable members of society who made a practice and were proud of driving fast trotters. A man then was given to depreciating the speed of any horse he owned—a state of mind which is curiously rare nowadays, when a man's powers of imagination rather incline to the contrary order of things. Little by little, however, it began to be recognized that a man could drive a fast horse and still be a respectable member of society. Speaking for myself, I may say that from the first day I took the lines in my hands I made one resolve which I have rigidly adhered to. It was that under no circumstance would I allow a horse owned by me to compete on the race-track for stakes. As soon as a horse enters my stable his public career is over. It was the knowledge of this fact which prevented my securing Dexter earlier in his career at a much lower price than I subsequently paid for him, and this is how it was: George Alley, as I dare say you know, bought Dexter for $200 odd, the original check with which he paid for his purchase being in my possession to-day. Under Alley's ownership Dexter soon began to develop his wonderful powers of speed. Well, one day Alley, who was then suffering from pecuniary pressure, came to me and offered me the horse for $15,000, stating that he had made certain time which was then below the record. I was not very eager at that time for the horse, but told Mr. Alley that if he would make that time in my presence at Fleetwood I would buy him. We went out to the track, but the well-known driver who then had him in hand did not want me to become his owner, as he knew that would be tantamount to the horse's retirement from the race-track. He accordingly pulled him in when making the trial, and refused to repeat the experiment. I of course said the bargain was off, and a short time after Alley sold him at auction to a man from Chicago for $14,000. A friend of this man about a year after asked me if I would give him $2,000 commission, supposing he obtained the horse for $33,000. I assented, and thus really paid $35,000 for the horse, who is now in my stables, as I suppose you know."

"Do you think the present system of trotting exhibitions prejudicial?"

"I think I must answer yes. Every true sportsman fears the degenerating of his sport into a form of hippodroming, and, judging from recent disclosures and the facts I know myself, that is what things are coming to. This trotting for the gate money and the prevalence of pool-selling on matches cannot be too severely condemned, and the latter I should like to see more severely punished and vigorously repressed by the authorities."

"Don't you think that these public trials of speed have done much to develop the trotter?"

"No. I think they principally serve to develop the gains of the gamblers. I myself make a rule of never attending a public match unless I want to see a new horse, or one I think of purchasing."

"To what do you attribute the rapid and marvelous lowering of the record in the last twenty years?"

"To several causes. In the first place, what I may call the mechanical adjuncts to the sport have been wonderfully improved. Our modern sulkies and buggies represent almost the perfection of scientific skill applied to carriage building. Friction and weight are reduced to a minimum, while strength and stability remain a maximum. Then, several seconds have been gained by the improved scrapers and rollers used to prepare the track. On my own farm, for instance, after using for some time a roller which I regarded as perfect, I was induced to try the latest novelty which is used at Fleetwood, and found I had gained two seconds at least by doing so. Then the introduction of toe-weights has done wonders in this direction. In fact, I think this latter invention has almost revolutionized the science of trotting, and will have a powerful influence on future breeding. It is to careful breeding, after all, that we must look for the greatest results in the future development of the trotting horse. Our original trotting stock, as you may know, came from Canada—the Kanuck stock as it was called; then Orange became the great breeding center, and a little better blood was bred from; now Kentucky, which for generations has been the home of the thoroughbred, is sending us our best animals. That, I think, is the great secret—the introduction of a thoroughbred strain. I do not think that one can breed a good trotter straight from a thoroughbred mare, but if you take the product of a trotter and a thoroughbred and breed that again to a good trotting stock, you are likely to get good results. That is the history of Jay-Eye-See's success. He has the staying properties of his thoroughbred ancestors. That staying power, united to the action of a good trotting strain, will make the ideal trotter of the future, and the action is nowadays become a greater matter of certainty, thanks to the kindly assistance of the toe-weights. Without those, for instance, Maud S. would never have become the horse that she is."

"What do you think will be the ultimate speed attained?"

"Well, I can only say that I have a horse in my stables that has trotted a quarter in 30¼; so when we manage by breeding to obtain that staying power I spoke of, I suppose a two minute record will be a common enough thing. A worthy mathematical professor has, I see, been calculating that the trotter will eventually equal the running horse in his speed. Every horseman must know this is absurd nonsense at first glance. A horse that has to be pulled in with tremendous force so as not to exert himself to the utmost can never equal the speed of one who is given his head and can proceed by a series of bounds as it were, and almost fly through the air. Trotting is after all an artificial gait, and must of necessity be slower than a natural one."

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